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EQUIPMENT TECHNOLOGIES MATERIALS

AVADANLIQLAR, TEXNOLOGİYALAR, MATERİALLAR

ОБОРУДОВАНИЕ, ТЕХНОЛОГИИ, МАТЕРИАЛЫ

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SYNERGETIC EFFECT OF STRENGTHENING POLYMER NANOCOMPOSITES

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ABSTRACT

According to the cluster model of glassy polymers, in the amorphous state they are natural nanocomposites of two components of a loosely packed matrix and nanoclusters immersed in it, respectively playing the role of a matrix and filler in a natural composite. In this interpretation of the polymer, an important role is played by the dimensional effect of nanoclusters, identical to the specified effect of a nanofiller in an artificial nanocomposite, namely, a decrease in the size of both nanoclusters and dispersed particles leads to a sharp increase in the degree of amplification (modulus of elasticity) of the nanocomposite.

In this paper, using parallel and sequential microcomposite models, upper and lower fractal estimates for the elastic modulus of the matrix are obtained and the synergistic effect of strengthening the elastic modulus of the nanocomposite as a whole as a superposition of the amplification effects from inorganic filler and from nanoclusters playing the role of filler of the loosely packed matrix is quantified.

The object of research in this work is a packer - a device designed to disconnect two zones of the borehole and isolate the internal space of the production column from the impact of the borehole environment. The tightness of the packages is achieved thanks to sealing elements (SE), for the manufacture of which a composite with the composition is used: a mixture of synthetic butadiene nitrile and hydrogenated butadiene nitrile rubber (BNC + HBNC), vulcanizer, stabilizer, technological additives and copper nanoparticles.

For the class of polymers under consideration, a rule has been developed for choosing the most preferred model from the above two micromechanical models at a given temperature.

Keywords: oilfield equipment, synergetic effect, cluster model, natural nanocomposite, interfacial region, inter-component adhesion, loosely packed matrix.

Relevance

Oilfield equipment (OFE) is operated under severe conditions characterized by significant dynamic loads, the intensity of abrasive wear and corrosion of the material in aggressive operating environments. These circumstances lead to a sharp drop in the resource of the OFE, an increase in the number of repairs and downtime, a decrease in the repair period and, consequently, to an increase in the cost of production.

Currently, a number of technical, technological and materials science solutions are being used to increase the resource of OFEs, among which nanotechnology and the use of composite materials occupy a special place. Polymer-inorganic composites are widely used in various fields of

technology due to the combination of polymer properties and functional filler, which makes it possible to obtain materials with adjustable characteristics depending on the ratio of components, the size of filler particles and synthesis conditions.

The object of research in this work is a packer - a device designed to disconnect two zones of the borehole and isolate the internal space of the production column from the impact of the borehole environment. The tightness of the packers is achieved thanks to sealing elements (SE), for the manufacture of which a composite with a composition is used: a mixture of synthetic butadiene nitrile and hydrogenated butadiene nitrile rubber (BNC + HBNC), vulcanizer, stabilizer, technological additives and copper nanoparticles. the object of the study is an in-field pipeline.

The aim of the work is to study the mechanism of formation of clusters and a loosely packed matrix in a natural nanocomposite.

The aim of the work is to study the mechanism of formation of clusters and loose–packed matrix in a natural nanocomposite.

The results of the study and their discussion

The polymer under study is considered as a natural nanocomposite; a cluster model was used to describe the structural features of its amorphous state. The physical foundations of the cluster model of glassy polymers in an amorphous state are described in [1]. Now almost all researchers recognize the existence of a local order (clusters) in the amorphous phase of a glassy polymer. Currently, the main problem is the exact structural identification of local border regions and the creation on this basis of a quantitative concept represented by a cluster model.

According to this model, a mesh polymer consists of two components – a loosely packed matrix and nanoclusters, the latter playing the role of a nanofiller, and a loosely packed matrix – the role of a matrix of a natural nanocomposite. In [2], based on fractal estimates of the surface of nanoclusters, the dependence of the volume fraction of the loosely packed matrix on the temperature of the composite was found. It is shown that the dimensional effect of nanoclusters is identical to the corresponding effect of dispersed filler in artificial polymer nanocomposites, namely: a decrease in the number of statistical segments in one cluster and the radius of clusters increases the degree of amplification (modulus of elasticity) of the natural nanocomposite [3]. Using a fractal model of interfacial interactions in [4], estimates of the threshold values of the volume fractions of nanoclusters of an epoxy polymer matrix and metallic filler nanoparticles were obtained, during the transition through which the process of mechanical stress transfer from the polymer matrix to the filler weakens.

One of the main tasks solved when introducing fillers into polymer matrices is to increase the rigidity of polymer nanocomposites, which is characterized by the magnitude of the elastic modulus (see, for example, [5,6]). In the case of treating the polymer as a natural nanocomposite, the dimensional effect of nanoclusters, identical to the specified effect of dispersed nanofillers in polymer nanocomposites, plays an important role: a decrease in the size of both nanoclusters and dispersed particles leads to a sharp increase in the degree of amplification (modulus of elasticity) of the nanocomposite [7]. In this connection, the question arises: how does the variation in the size of the nanocluster and its fractal size quantitatively affect the magnitude of the elastic modulus of the nanocomposite.

This paper is devoted to solving this problem. To describe the behavior of the elastic modulus $E_м$ natural nanocomposites, two of the simplest microcomposite models were used – parallel and sequential – giving an upper and lower estimate of this parameter [8].
The value of the elastic modulus of the matrix $E_м$ in the parallel model is defined as

$$E_м = E_{кл} \cdot \varphi_{кл} + E_{р.м.}(1 - \varphi_{кл}) \tag{1}$$

and for the sequential model

$$E_м = \frac{E_{кл} \cdot E_{р.м.}}{E_{кл}(1-\varphi_{кл}) + E_{р.м.} \cdot \varphi_{кл}} \tag{2}$$

where $\varphi_{кл}$ is the volume fraction of the cluster in the matrix; $E_{кл}$ and $E_{р.м.}$ are the elastic modulus of the cluster and the loosely packed matrix, respectively.
Based on the upper and lower estimates, a double synergistic effect of strengthening the elastic modulus of a nanocomposite was identified and quantified as a superposition of the amplification effects from an inorganic filler and from nanoclusters playing the role of a filler of a loosely packed matrix.
Within the framework of the cluster model, the structure of the amorphous state of polymers represents regions of local order (clusters) that are immersed in a loosely packed matrix consisting of free chains in terminology [9]. In general, an increase in the proportion of loosely packed regions leads to increased molecular mobility.
From a synergetic point of view, during the formation of nanostructures in natural nanocomposites, the relative proportion of $\varphi_{кл}$ clusters in the amorphous state of a mesh polymer is a structure parameter in the strict physical sense of the word.
With comparable values of the elastic modulus of the cluster, $E_{кл}$, and the loosely packed matrix, $E_{р.м.}$, for a glassy mesh polymer, the transfer of applied stress is realized through both structural components of the polymer (loosely packed matrix and nanoclusters), i.e. in this case the parallel microcomposite model indicated above is applicable. For the unpeeled polymer ($E_{кл} \gg E_{р.м}$) at $E_{р.м.} \to 0$) only sequential voltage transfer through nanoclusters and "pass-through" circuits connecting them is possible, i.e. a sequential model is applicable.
Considering together the equation

$$\frac{E_м}{E_{р.м.}} = 1 + 11 \cdot \varphi_{кл}^{1,7} \tag{3}$$

with the Kerner equation

$$\frac{G_м}{G_{р.м.}} = \frac{\varphi_{р.м} \cdot G_{р.м.} + (\alpha_{р.м.} + \varphi_{кл}) \cdot G_{кл}}{(1 + \alpha_{р.м.} \cdot \varphi_{кл}) \cdot G_{р.м.} + \alpha_{р.м.} \cdot \varphi_{р.м.} \cdot G_{кл}}, \tag{4}$$

where $G_м$ and $G_{р.м.}$ – modules of matrix shift and loosely packed matrix; $\varphi_{р.м.} = 1 - \varphi_{кл}$; $\alpha_{р.м.} = 2\left(4 - 5\nu_{р.м.}\right)/\left(7 - 5\nu_{р.м.}\right)$, $\nu_{р.м.}$ – the Poisson's ratio of a loosely packed matrix, determined from the equations

$$d_f^{р.м.} = (d - 1)\left(1 + \nu_{р.м.}\right), \tag{5}$$

$$d_f^{\text{м}} = d_f^{\text{р.м.}}(1-\varphi_{\text{кл}}) + d_f^{\text{кл}} \cdot \varphi_{\text{кл}}, \quad (6)$$

taking into account equality $d_f^{\text{м.}} = (d-1)(1+\nu_{p.\text{м}})$ ($d_\mu^{\text{м}}$ and $\nu_{\text{м}}$ – fractal dimension and Poisson's ratio of the polymer matrix) and the fact that the value of the fractal dimension $d_f^{\text{кл}}$ due to the packing of clusters, it is assumed to be equal to the maximum dimension of real solids $d_f^{\text{кл}} = 2{,}95$ [10]) we get at the test temperature T

$$G_{\text{кл}}(T) = C_1(T) \cdot G_{p.\text{м.}}(T),$$

$$C_1(T) = \left[\frac{d_f^{\text{р.м.}}}{d_f^{\text{м}}}(1+\alpha_{p.\text{м.}} \cdot \varphi_{\text{кл}}) - \varphi_{p.\text{м.}}\right] \Big/ \left(\alpha_{p.\text{м.}} + \varphi_{\text{кл}} - \alpha_{p.\text{м.}} \cdot \varphi_{\text{кл}} \frac{d_f^{\text{р.м.}}}{d_f^{\text{м}}}\right) \quad (8)$$

From where we find $E_{p.\text{м.}}(T) = C_2(T) \cdot E_{\text{м}}^{\text{экс}}(T)$, $C_2(T) = 1/(1+11\varphi_{\text{кл}}^{1{,}7})$, (8)

$$E_{\text{кл}}(T) = C_2(T) \cdot E_{\text{м}}^{\text{экс}}(T), \quad C_3(T) = C_1(T) \cdot C_2(T) \cdot \frac{d_f^{\text{кл}}}{d_f^{\text{р.м.}}}, \quad (9)$$

Test temperature range $\Delta_T = [T^{\text{нач}}, T^{\text{кон}}]$ it is divided into two subintervals $\Delta_T^{(1)} = [(T^{\text{нач}}, T_c')$ and $\Delta_T^{(2)} = (T_c', T^{\text{кон}}]$. According to the cluster model [1,11], at a temperature of $T_c' \approx T_c - 50K$, unstable nanoclusters that hold the loosely packed matrix in a glassy state occur, as a result of which this structural component is uncovered in the temperature range $T_c' \div T_c$.

According to the parallel model (1) for $T \epsilon \Delta_T^{(1)}$ we get

$$E_{\text{м}}^{\text{теор}}(T) = C_4(T) \cdot E_{\text{м}}^{\text{экс}}(T), \quad C_4(T) = C_3(T)\varphi_{\text{кл}} + C_2(T)(1-\varphi_{\text{кл}}), \quad (10)$$

from where for the standard deviation $RSS^{\text{парал}} = \sum_{T\epsilon\Delta_T^{(1)}} \left(E_{\text{м}}^{\text{теор}}(T) - E_{\text{м}}^{\text{экс}}(T)\right)^2$ finding an estimate

$$RSS^{\text{парал}} = \sum_{T\epsilon\Delta_T^{(1)}} [C_4(T) - 1]^2, \quad (11)$$

According to the following model (2) for $T \epsilon \Delta_T^{(1)}$ we obtain

$$E_{\text{м}}^{\text{теор}}(T) = C_5(T) \cdot E_{\text{м}}^{\text{экс}}(T),$$
$$C_5(T) = C_2(T) \cdot C_3(T)[C_3(T)(1-\varphi_{\text{кл}}) + C_2(T)\varphi_{\text{кл}}], \quad (12)$$

from where we find

$$RSS^{\text{посл}} = \sum_{T\epsilon\Delta_T^{(1)}} [C_5(T) - 1]^2, \quad (13)$$

The dependence of $\varphi_{\text{кл}}$ on the test temperature T is determined by the ratio [12]

$$\varphi_{\text{кл}} \approx 0{,}038(T_c - T)^{0{,}55}$$

where T_c is the glass transition temperature of the polymer.

From the values of values (11) and (12), it can be concluded that if $RSS^{\text{парал}} < RSS^{\text{посл}}$, then for the glassy state of the polymer (i.e. at $T\epsilon\Delta_T^{(1)}$), the parallel model (1) is most preferable, otherwise it is most preferable sequential model (2).

Conclusion

Based on the study of the variation in the size and fractal dimension of nanoclusters, a quantitative effect of strengthening the elastic modulus of the nanocomposite was obtained. A glassy polymer in an amorphous state is, within the framework of the cluster model concept, a natural nanocomposite in which a loosely packed matrix plays the role of a matrix, and a nanocluster plays the role of a filler. At a fixed temperature, the choice of the best alternative from two micromechanical models (parallel and sequential) is determined by estimating the standard deviation of the calculated value of the elastic modulus of the matrix with experimental data.

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СИНЕРГЕТИЧЕСКИЙ ЭФФЕКТ УСИЛЕНИЯ ПОЛИМЕРНЫХ НАНОКОМПОЗИТОВ

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РЕЗЮМЕ

Согласно кластерной модели стеклообразных полимеров, в аморфном состоянии они представляют собой естественные нанокомпозиты из двух компонентов рыхлоупакованной матрицы и погруженных в нее нанокластеров, играющих соответственно роль матрицы и наполнителя в естественном композите. В данной трактовке полимера важную роль приобретает размерный эффект нанокластеров, идентичный указанному эффекту нанонаполнителя в искусственном нанокомпозите, а именно, уменьшение размеров и нанокластеров и дисперсных частиц приводят к резкому повышению степени усиления (модуля упругости) нанокомпозита.

В настоящей работе с использованием параллельной и последовательной микрокомпозитных моделей получены верхняя и нижняя фрактальные оценки для модуля упругости матрицы и количественно оценен синергетический эффект усиления модуля упругости нанокпозита в целом как суперпозиция эффектов усиления от неорганического наполнителя и от нанокластеров, играющих роль наполнителя рыхлоупакованной матрицы.

Объектом исследования в данной работы является пакер - устройство, предназначенное для разобщения двух зон ствола скважины и изоляции внутреннего пространства эксплуатационной колонны от воздействия скважинной среды. Герметичность пакеров достигается благодаря уплотнительных элементов (УЭ), для изготовления которых используются композит с составом: смесь синтетического бутадиеннитрильного и гидрогенизированного бутадиеннитрильного каучука (БНК+ГБНК), вулканизатор, стабилизатор, технологические добавки и наночастицы меди.

Для рассматриваемого класса полимеров разработано правило выбора наиболее предпочтительной модели из указанных выше двух микромеханических моделей при заданной температуре.

Ключевые слова: нефтепромысловое оборудование, синергетический эффект, кластерная модель, естественный нанокомпозит, межфазная область, межкомпонентная адгезия, рыхлоупакованная матрица.

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THE STUDY OF THE CAUSE OF FAILURE OF THE MAIN ELEMENTS OF THE CHIRTMAS TREE AND EFFECTIVE SOLUTION WAYS

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ABSTRACT

The article is devoted to the study of the causes of failures of fountain fittings in the process of operation, the measures taken to eliminate failures, increase efficiency and increase the overhaul period. İn order to improve the efficiency of the fountain fittings, the works that can be performed during major and current repairs are investigated. The main purpose of this article is to increase the reliability of the design of the fountain fittings.
This article explores the causes of failure that may occur in wellhead christmas trees, their causes and solutions. The general design of x-mas trees is shown. Basically, christmas tree fittings are cross-shaped, three-necked and, depending on the design, for a working pressure of 21, 35, 70, 105, 140 MPa.
x-mas trees perform the main and most important work, such as hanging tubing, shutting off the wellhead, providing the necessary pressure on the wellhead, and regulating oil production. As is known, during the operation of oil and gas wells, along with the main product, clay, sand and abrasive particles are removed from the well. Among these impacts, christmas trees are exposed to the corrosive attack of sand flowing with oil, gas and water during operation. It is the cross and the connecting elements of the x-mas tree - closing valves, the cross, the christmas tree, a pair of gates - saddles, the sealing elements that are most susceptible to eating (wear). Due to the fact that these processes occur under high pressure, a number of important requirements are imposed on the design of x-mas trees. İmproving the design of x-mas trees, which is wellhead equipment, is always one of the most important tasks in operation. In order to improve the efficiency of x-mas trees, the works that can be performed during major and current repairs have been studied. The main purpose of this article is to study the improvement of the reliability indicators of the x-mas tree design, increase the overhaul period.
Keywords: Christmas tree, stem, valve, globe valve,packing element, shut-off valve, disc - saddle pair.

Introduction

Christmas tree is used in the process of operating oil and gas wells for the purpose of ensuring the condition of the wellhead. Christmas tree construction is mainly used in oil exploration and production in surface and underwater oil and gas wells. Surface christmas tree are used to prevent sudden fountains in onshore oil and gas wells and to close the wellhead. The underwater christmas tree has a more complex construction and is used in the operation of oil and gas wells at a certain depth of water.
The operating conditions of oil, gas and gas condensate wells require that those wells be hermetically sealed (sealed), the spaces behind the pipes are isolated (captured), the oil or gas

product is directed to collection points, and the well can be fully closed under pressure if necessary. These requirements are fulfilled by the belt head and the chirtmas tree(with the manifold) installed above the fountain well.
In this research work, failures that may occur in the underground christmas tree, their causes and elimination methods were investigated. The general construction of the christmas tree is shown in Figure 1. Generally, according to the structure, the cross is three-sided and the working pressures are 21,35,70,105,140 MPa of the christmas tree is shown in Figure 1.

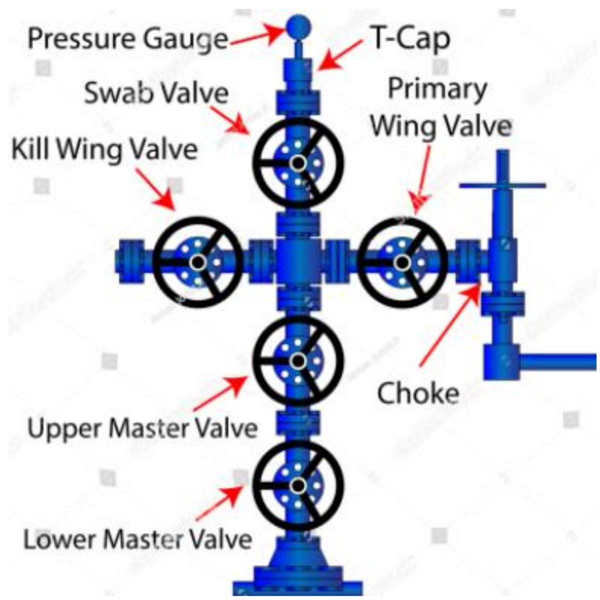


Figure 1: The principle scheme of the Christmas tree

Relevance: As we mentioned, the christmas tree performs the main and most responsible work, such as hanging service pipes, closing the wellhead, providing the required pressure at the wellhead, and regulating oil production. Since these processes take place under high pressure, several important requirements have been placed on the construction of the christmas tree . İmproving the construction of christmas tree , which is a wellhead equipment, is always one of the most important problems in production. Generally, according to the structure, the cross is three-sided and the working pressures are 21,35,70,105,140 MPa [1]. İn addition, the fittings are threaded or flanged. Recently, mainly flange fittings are made. These fittings are more reliable at high pressure. Christmas tree are one of the most pressurized equipment in oil and gas production. For this reason, during the production of the equipment, all cast parts are collected after hydraulic testing at a pressure 1.5 times higher than the working pressure at the factory and generally retested. Nevertheless, the fittings sent for installation from the mine workshop must be hydraulically tested again. A maximum torque wrench is used to tighten the flanges. When it is closed by hand, the cross must be pressed gradually in sequence. All parts of the christmas tree are made of quality steel depending on their pressure. Between the flanges, an annular intermediate layer made of mild steel with an oval cross-section is placed. If defects of hollow parts are detected during the test, they can be welded with the appropriate electrode only once if

they are in accordance with the technical condition. İf it still misses on the retry, it is thrown out completely. The ends of the fittings must be closed with metal caps for transportation. As it can be seen, the equipment is the most important equipment used in the operation of oil and gas wells, which is subjected to the most pressure and requires high precision in its processing. The failure of individual nodes on the christmas tree at high pressure always results in financial damage to enterprises. İt also slows down the work process. İncreasing the reliability quality of the pressure-sensitive parts of the christmas tree and extending the interval between repairs has always been one of the most important issues [2].



Figure 2: Simple construction of the Christmas tree

Objective

As we know, in the operation of oil and gas wells, along with the main product, clay, sand and abrasive particles are removed from the well. Among these effects, the christmas tree is exposed to the corrosive effect of sand flowing together with oil, gas and water during operation. The triad and connective structures of the christmas tree are the most subject to wear. Often eaten valves are replaced directly above the well. The christmas tree as a whole should be regularly inspected ("revision"), even if it has not been observed malfunctions in the work process or has worked reliably. İn this article, a flange joint christmas tree designed for a pressure of 70 Mpa is investigated. İnspection and repair of the christmas tree is carried out in the workshop, for which it is necessary to disassemble it and separate it into separate nodes and parts. Dismantling a flanged christmas not difficult, as the bolts attached to the flanges are easy to unscrew. And they cut the bolts whose grooves are crushed. But dismantling the threaded armature creates great difficulties. İn this case, the opening of the grooves is obtained either by hand, with two chain wrenches, or by fastening and opening the zinc cable of the winch (repair winch) to the slotted wrench. They do not put the christmas tree on the base, but bolt the flange of the cover to the flange of the valve support. The support is connected to the coupling of the pipes from the cross,

which are seated with the support so that the upper flange of the cross is 0.7 m above the well floor. The hole in the upper flange opens up so that various sizes of fittings can be attached. The side exit of the cross serves to hold the repaired valve. The dismantled fountain christmas tree is washed and its individual parts are looked at. If there are cracks in the parts, such parts are cut out ("brakovka"). The trickiest part of repairing a fountain faucet is its valves. First, the valves are checked for easy opening and closing. Then the cover is dismantled, the flywheel is removed together with the shaft (spindle) and the connecting part (wedge, plates, valve or plug), the condition of the sealing surfaces is checked [3].
Failures that can occur in the most responsible nodes of the christmas tree and their elimination methods are listed below [4].

A) Possible problem in plug faucets and their elimination methods
1) Problem - Leakage of the working agent from the thread connection of the clamping bolt and the spindle [5].
Reason - Lack of lubricant, failure of the mold, high pressure destroys the mold,
Solution - Open the clamping bolt, add oil to the tap and close the clamping bolt, if the corrosion rate of the clamps exceeds the norm, the clamps should be replaced.
2) Problem - Leakage of the working agent through the valve of the adjusting screw
The reason - the chip is eaten, insufficiently compressed, some loosening due to the effect of unevenly distributed forces during the work process. Eating graphite
The solution option is to change the rubber and graphite of packing, or re-surface the graphite on a high-precision CNC machine with a rubber press and put it in place.
3) Problem - Leakage of the working agent through the seal between the cap and the body
Cause – The cover is loosely clamped. The faucet does not open and close. The material has not been selected yet [6].
Solution option - Add conditioning oil to the faucet and tighten the cap, perform a power report of the faucet and reengineer the product nodes.
4) Problem - The valve plug is difficult to close or does not close at all
Reason - Riveting of the plug in the body.İmproper selection of the lubricant, no need to fully open and close the faucet during operation, eating the plug,
Solution - Using a tightening bolt, the plug should be dislodged, if the problem does not go away, the faucet should be disassembled and lubricated. It should be replaced if it has already been eaten to the limit of traffic jam.

B) Possible faults in straight-flow valves and their elimination methods
1) Problem - Leakage from spindle or stock valve [7].
Reason – packing (cuff) was eaten. There is no lubricate in packing. Spindle or stock neck is damaged. The material report was not made correctly. Cracks have formed in the graphite.
The solution- option is to change packing . Must hit the pie. İf there are cracks in the collar, it must be thoroughly repaired.
2) Problem - During the process of opening and closing the shutter, the torque on the regulator wheel increases sharply.
Reason - Spindle support pad is broken. The T-shaped crack is broken. There is no oil in the body of the pillow. Freezing of hydrate in the trunk.

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Solution - The valve needs to be replaced. Oil should be injected. The body should be heated with hot water or steam, and the pads should be changed. İn general, operating pressure should be considered as a safety factor when selecting cushions [8].

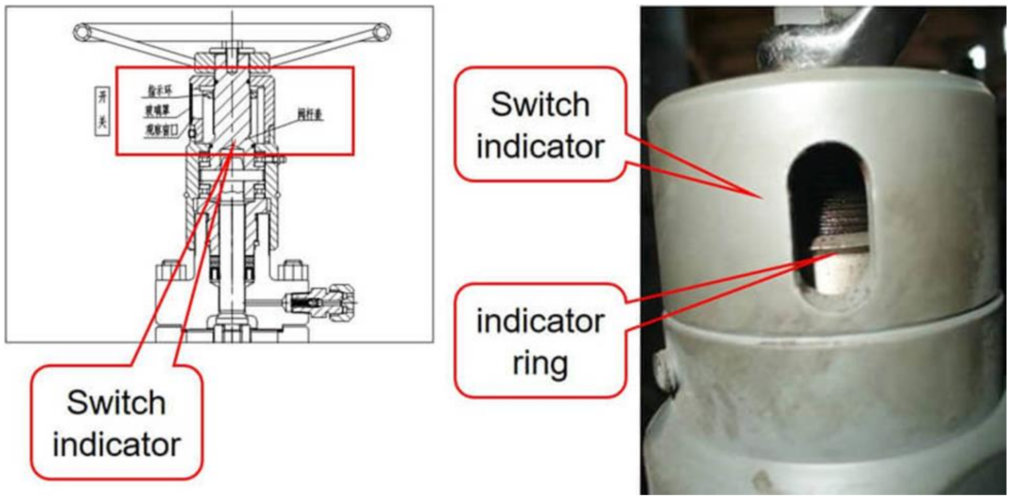


Figure 3: Schematic of the connector.

3) Problem – Valve latch is rusted (adjustment wheel does not rotate)
Reason - The working surfaces of the cheeks of the shutter are dirty. Falling of water or condensate into the internal volume of the body and their freezing.
Solution - Wash the valve in stationary conditions. The valve should be heated, drained and oiled.
4) Problem: The valve does not open and close completely [9].
Reason: The presence of sand or solution in the body, molding of the valve due to long-term operation in the same conditions, reduction of the lubricant,
Solution: The valve should be washed and filled with oil under stationary conditions
Possible malfunctions in straight-flow valve and their elimination methods. The quality of the rub is checked by the "coloring" test. Defects of the slide are determined by measurement and restored by the method of "surfacing", then mechanical processing is carried out so that the part can get the original size and the necessary surface cleanliness. İn this way, the connecting structures and the body are repaired.
Molding surfaces are cleaned by rubbing before harvesting. When there is a lot of corrosion in the connecting structures, they are replaced with a new one. The spindle is checked for straightness and suitability of the threads. The groove must be full, clean and not crushed. İf the tip of the upper square is turned, then it must be cut again. Restoration of the valve grooves is performed in the above manner. Thus restored and replaced with new parts and nodes are realigned and assembled opposite to disassembly. The assembled coolant is checked with a hydraulic hand press according to the technical condition to the test pressure. The christmas tree is assembled on the stand used for dismantling. The grooves should be lubricated with "graphite" lubricant before closing. Also, special attention should be paid to the assembly of sealing rings and packing.

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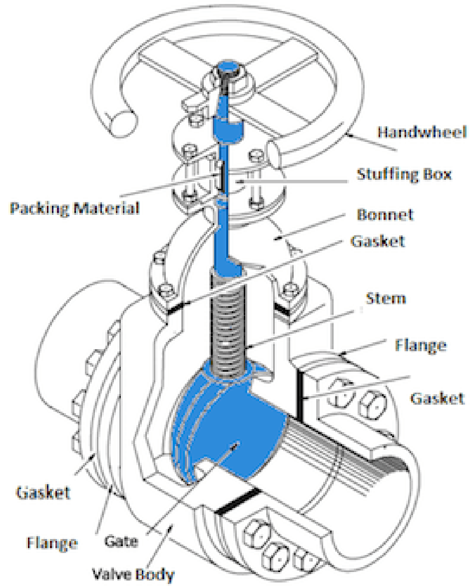


Figure 4: The principle scheme of the valve

Tightening of bolt connections must be performed according to the rules specified in the technical condition. The barrel of the christmas tree is checked with a template 2 m long according to the diameter. After the assembly of the christmas tree, the tightness of all its joints is checked to the test pressure (the pressure is pressed).



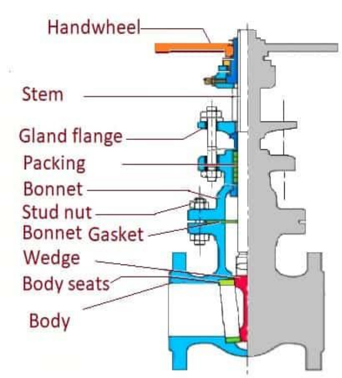




Figure 5: General structure and main details of the valve

Result

As a result of the conducted scientific research, it can be noted that the most responsible loading part of the christmas tree was valves and faucets. The most common problems found in valves are chipping, loosening due to pressure, warping and breakage. Solutions to these problems were proposed. Also, to increase the time between major repairs, attention should be paid to the following nuances.

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İn oil and gas operations, the crane is often in the same state: open or closed, during the interrepair period. İf these valves do not release liquid or gas, then a "visual" inspection of the assembly is sufficient, and it is enough to replace the packing with a new one. İf the sealing surfaces are corroded, they should be polished. If the depth of the dent is 0.1 mm, it is enough to remove it by rubbing, and then it is necessary to clean with a medium and thin "paste" (powdered lubricant).

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FONTAN ARMATURUNUN ƏSAS ELEMENTLƏRİNİN SIRADAN ÇIXMA SƏBƏBİ VƏ EFFEKTİV HƏLL YOLLARININ TƏDQİQİ

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XÜLASƏ

Məqalədə iş prosesi zamanı fontan armaturunda baş verən imtinaların səbəbləri araşdırılmış, tədqiqi, imtinaların aradan qaldırılması, iş qabiliyyətinin yaxşılaşdırılması və təmirlər arası müddətin artırılması üçün görülən tədbirlər tədqiq edilmişdir. Fontan neft, qaz və qazkondensat quyularının istismar şəraiti tələb edir ki, həmin quyular hermetikləşdirilsin (kipləndirilsin), boruarxası fəzalar izolə edilsin (tutulsun), neft və ya qaz məhsulu yığım məntəqələrinə istiqamətləndirilsin, həmçinin lazım gəldikdə təzyiq altında quyu tam bağlansın. Bu tələbləri fontan quyusunun üstündə quraşdırılan kəmər başlığı və fontan armaturu (manifoldla birlikdə) yerinə yetirir.
Bu məqalədə quyuağzı fontan armaturunda baş verə biləcək imtinalar, onların səbəbi və aradan qaldırılma yolları araşdırılmışdır. Fontan armaturunun ümümi konstruksiyası göstərilmişdir. Ümümiyyətlə, fontan armaturları quruluşuna görə xaçvarı, üçboğazlı və işçi təzyiqləri 21,35,70,105, 140 MPa olurlar.
Fontan armaturu istismar borularının asılması, quyu ağzının bağlanması, quyu ağzında tələb olunan kipliyi təmin etmək və neft hasilatının tənzimlənməsi kimi əsas və ən məsul iş görür. Bildiyimiz kimi, neft-qaz quyularının istismarında quyudan əsas məhsulla bərabər gil, qum və abraziv hissəciklər də xaric olunur. Butun bu təsirlərdən fontan armaturu istismar prosesində neft, qaz və su ilə birgə axan qumun yeyici təsirinə məruz qalır. Ən çox yeyilməyə (aşınmaya) məruz qalan yolkanın üçboğazı və bağlayıcı quruluşlarıdır. Bu proseslər yuksək təzyiq altında baş verdiyinə görə fontan armaturunun konstruksiyasına bir neçə önəmli tələblər qoyulmuşdur. Quyu ağzı avadanlıq olan fontan armaturunun konsturksiyasını təkmilləşdirilməsi hər zaman istehsalatda ən önəmli problemlərdən biridir. Fontan armaturunun iş qabiliyyətinin yaxşılaşdırılması məqsədilə əsaslı və cari təmirdə görülə biləcək işlər araşdırılmışdır. Bu elmi işdə ən əsas məqsəd fontan armaturunun konsturuksiyasının etibarlılıq göstəricilərini yaxşılaşdırmaq, əsaslı təmirlər arası vaxtı artırmaqdır.
Açar sözlər: Fontan armaturu, şpindel, siyirtmə, kipkəc,bağlayıcı ventil, sürgü – yəhər cütlüyü.

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ИССЛЕДОВАНИЕ ПРИЧИНЫ ОТКАЗА ОСНОВНЫХ ЭЛЕМЕНТОВ ФОНТАННОЙ АРМАТУРЫ И ПУТИ ИХ ЭФФЕКТИВНОГО РЕШЕНИЯ

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РЕЗЮМЕ

Статья посвящена исследованию причин возникновения отказов арматуры фонтана в процессе работы, принятым мерам по устранению отказов, повышению работоспособности и увеличению межремонтного периода. С целью повышения работоспособности арматуры фонтана исследованы работы, которые могут быть выполнены при капитальном и текущем ремонте.Основной целью данной статьи является повышение показателей надежности конструкции арматуры фонтана.
В данной статье исследуются причины отказа, которые могут возникать в устьевых фонтанной арматуре, их причины и пути устранения. Показана общая конструкция фонтанной арматуры. В основном фонтанная арматура бывает крестовой, трехгорловой и в зависимости от конструкции на рабочее давление 21, 35, 70, 105, 140 МПа.
Фонтанная арматура выполняют основную и наиболее ответственную работу, такую как подвеска насосно-компрессорных труб, перекрытие устья, обеспечение необходимого давления на устье, регулирование добычи нефти. Как известно, при эксплуатации нефтяных и газовых скважин наряду с основным продуктом из скважины удаляются глина, песок и абразивные частицы. Среди этих воздействий фонтанная арматура подвергается коррозионному воздействию песка, стекающего с нефтью, газом и водой в процессе эксплуатации. Именно крестовина и соединительные элементы фонтанной арматуры – закрывающие вентили, крестовина, фонтанная елка, пара шибер –седла, уплотнительные элементы наиболее подвержены поеданию (износу). В связи с тем, что эти процессы происходят под высоким давлением, к конструкции фонтанной арматуры предъявляется ряд важных требований. Совершенствование конструкции фонтанной арматуры, являющейся устьевым оборудованием, всегда является одной из важнейших задач в эксплуатации. С целью повышения работоспособности фонтанной арматуры исследованы работы, которые можно производить при капитальном и текущем ремонте. Основной целью данной статьи является исследование улучшение показателей надежности конструкции фонтанной арматуры, увеличение межремонтного периода.
Ключевые слова: Фонтанная арматура, шпиндель, задвижка, уплотнитель, закрывающий вентиль, запорная арматура, пара шибер-седло.

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ANALYSIS OF THE DESIGN OF THE SWELLING PACKER AND RESEARCH OF DAMAGE TO THE SEALING UNIT

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ABSTRACT

The article provides a distinctive analysis of swelling packers used in different countries, considers the classification of packers. The principles of functioning of both mechanical packers and hydraulic packers, as well as swelling packers, are briefly considered, and their difference in functioning, opening time and holding time relative to swelling packers is also described. The advantages of swelling packers over other packages are presented. The superiority and key aspects of sealing elements of specifically swelling packers relative to mechanical and hydraulic packers are described, since some rubber materials included in the sealing element have the ability to self-repair sealing properties. The stages of development, properties of elastomers, which are used in the sealing elements of the packer, are given. Protective anti-extrusion rings are described, which protects the sealing units and elements from the indentation of the elastomer. The description of the varieties of swelling packers, the process of swelling, the advantages and disadvantages of swelling packers is given. The damage to the rubber of the sealing assembly of the swelling packer after testing in the well was analyzed. The elastomer of the sealing unit has been tested using various methods. The method of infrared spectroscopy revealed the approximate type of material and a change in the structure. Changes in the physicomechanical values of the rubber seal before and after thermo-oxidative aging are determined. The strength of the rubber polymer part of the packer from the effects of aggressive media was determined.
Keywords: swelling packer, sealing unit, elastomer element, damage, mechanical packer, destruction, hydraulic packer, pressure, temperature.

Introduction

One of the most effective ways to isolate reservoir zones and prevent overflows is the method of packing wells with various packer designs.
Packer (packer – English sealer) is a device designed to separate individual zones of the wellbore and isolate the internal space of the production column from the impact of the borehole environment. Packers are lowered into a well with casing strings and installed at the desired interval.
According to the installation method, packers are divided into mechanical, hydromechanical and hydraulic. The mechanical packer expands when it is not affected by the axial load - the mass of the tubing (tubing). The sealing rubber of the hydraulic packer expands when liquid is fed into it.
Mechanical packers are relatively simple in design, but at the present time the weight of the pipe column is no longer enough to seal and isolate the zones. In this connection, hydraulic packers are used more, but they are complex in design and are able to withstand large differential pressures, i.e. pressure drops.



Figure 1: General view of swelling packers

At the present time, the use of swelling packers is widely used (Figure 1). In these packers, the sealing element made of a special elastomer increases in volume by coming into contact with certain liquids – water, water-based solutions, oil, hydrocarbon-based solutions, or drilling mud. Due to the swelling of the elastomer, the annular space in the cased and unsettled boreholes is clogged, thereby ensuring the sealing of individual parts of the borehole.
Elastomer is a highly elastic elastic material that stretches to a size exceeding its original length and the ability to return to its initial size when no load is applied.
Various rubbers and rubbers are typical elastomers.

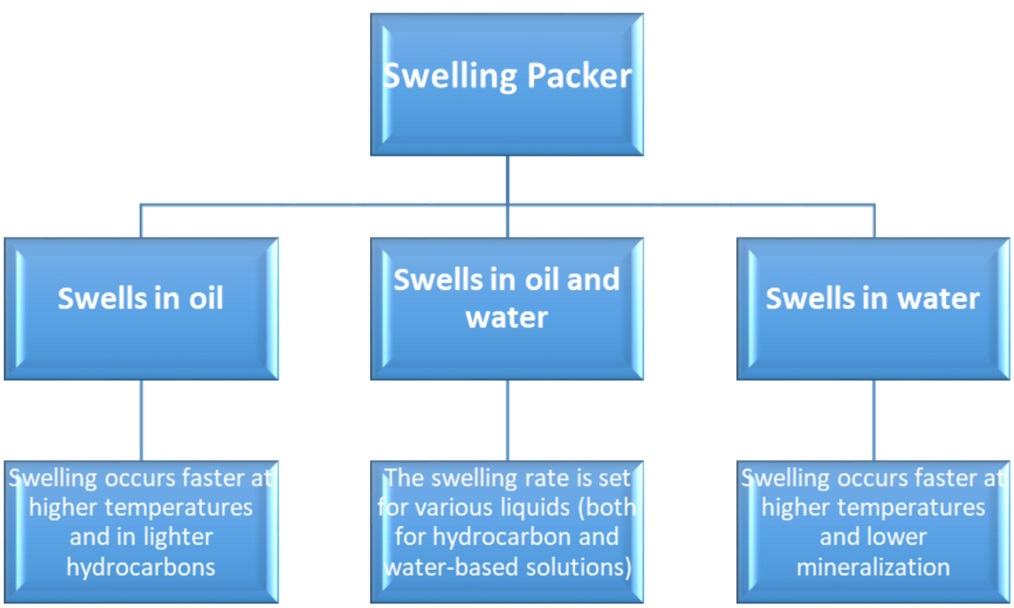


Figure 2: Classification of swelling packers

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Packers swelling in water. Such packers have a sealing element that swells by reacting with water and water-based solutions (figure 3). At high temperatures and weak mineralization, the volume of the water-swelling elastomer increases more intensively.

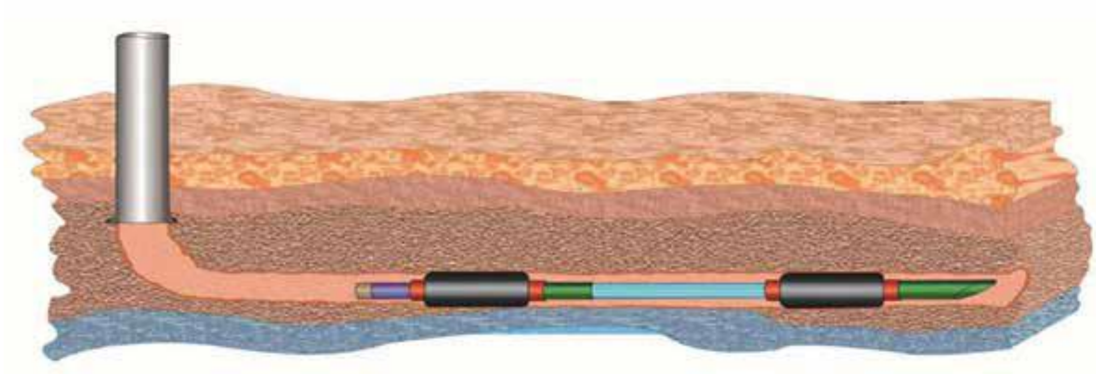


Figure 3: Packers swelling in water

Packers swelling in oil. Such packers have an elastomer that swells upon contact with hydrocarbon-based rastovors, i.e. oil, hydrocarbon-based drilling fluids (figure 4). With lighter hydrocarbons and higher temperatures, this packer increases in size better.



Figure 4: Packers swelling in oil

Hybrid Packers

In hybrid packages, the sealing element swells, reacting with both water, water-based solutions, and oil, hydrocarbon-based solutions and hydrocarbon-based drilling fluids (Figure 5). A hybrid packer is used if the type of borehole fluid is unknown. In this case, the swelling rate is set for both hydrocarbon-based and water-based solutions. The sealing element of a hybrid packer can consist of either a whole piece of rubber or in the form of separate sections. In swelling packers,

as a rule, the swelling rate is regulated by the choice of elastomer and the use of various kinds of coatings.



Figure 5: Hybrid packer in the well

Advantages of swelling packers

The advantage of swelling packers is that there are no moving parts in their design, which avoids a special operation. The sealing element in the swelling packages has the ability to independently repair and seal properties. Also, the advantage of such packers is that their use provides reliable and irreversible isolation of layers.

The experimental part

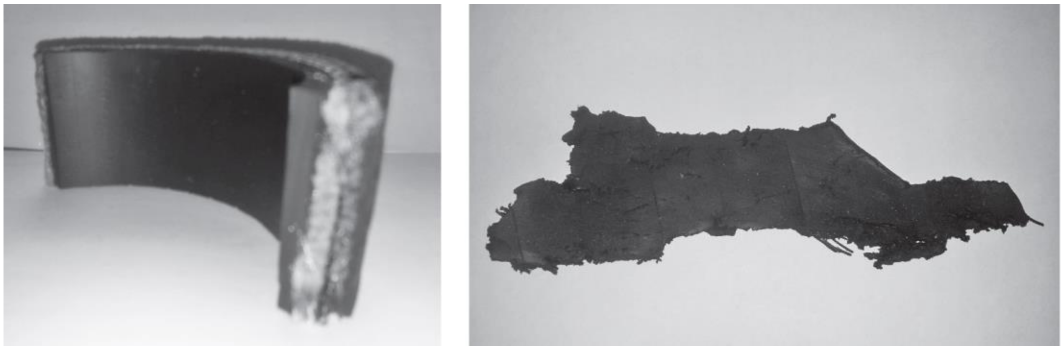
The purpose of the study is to analyze the damage and wear of the rubber seal of the swelling packer and search for methods for their early detection.

The well has a depth of 1300 m. From the mouth to a depth of 1060m of the well of a cased production column with an outer diameter of 168 mm. Below the well to the bottom has an open trunk with a diameter of 148 mm. The first landing of the packer was in the depth range from 1200 to 1250 m, when the tubing was installed between the partners with a length of 54 m and a diameter of 73 mm. Check the landing of the packer or by pumping oil at a pressure of up to 40 atmospheres through the tubing. The face temperature is 120°C.

The analysis by infrared spectroscopy was performed on a Thermo Scientific Nicolet spectrometer with a single reflection and a ZnSe crystal. The analysis for comparison was carried out using the built-in Thermo Scientific database. Shore A hardness of the rubber-polymer part was determined according to GOST. The density of the rubber part according to GOST was determined by the hydrostatic method. Determination of resistance to thermo-oxidative aging was carried out after holding the samples at 120 ° C for 24 hours according to the values of hardness and rebound elasticity before and after aging. In the figure 6 is a — before the test and b — after the test (damaged).

The rubber of the packer (figure 6) consists of a multilayer material. The exact composition is not known. The inner layer with a thickness of 5 mm is made of general-purpose rubber based on butadiene-nitrile rubber. The middle layer is made of several polymer fiber fabrics based on acrylamide. The outer layer is made of very dense rubber with a thickness of 3 mm. The damaged sample (figure 6-b) of the packer has no defined shape. When exposed to an oil-acid emulsion, the damaged sample has an oily odor characteristic of hydrocarbons. With a small contact, it is easily destroyed. A study of the density of the samples of the rubber part of the packer showed that the

outer sample has a density of 1.27 g/cm3, and the inner one has a density of 1.26 g/cm3. It is most likely that the outer and inner layers are made of rubber of the same composition.



a b

Figure 6: Photos of packer rubber samples.

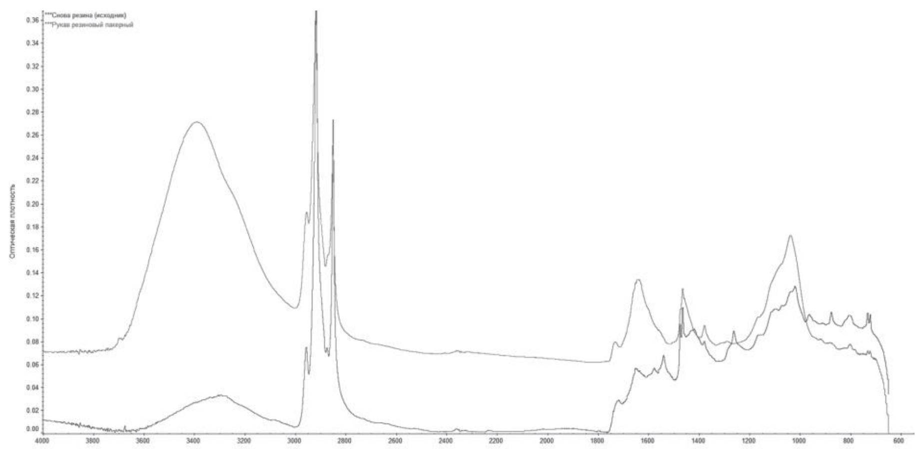


Figure 7: Infrared spectra of rubber part samples

The following absorption bands are observed on infrared spectroscopy (figure 7): in the region of 3500-3000 cm^{-1}, corresponding to fluctuations of free OH groups; in the region of 3000-2700 cm^{-1}, corresponding to the hydrocarbon part; in the region of 1800-1400 cm^{-1}, corresponding to the presence of multiple bonds; in the region of 1200-1000 cm^{-1}, corresponding to the inorganic part.

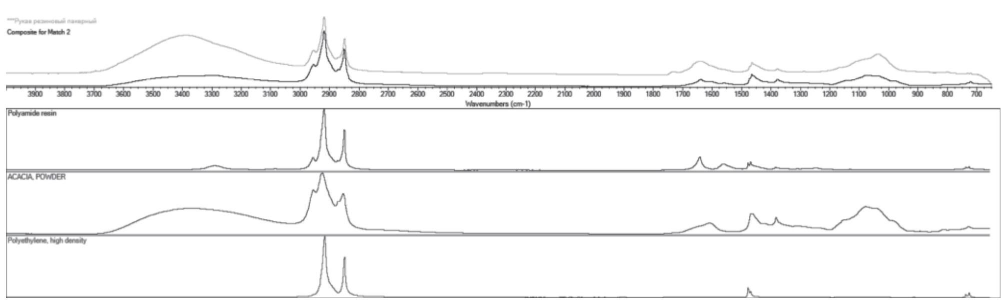


Figure 8: Infrared spectra of rubber part samples after comparative analysis using the Thermo Scientific database

The infrared spectra of the samples were also processed in the Thermo Scientific electronic database. Figure 8 shows the infrared spectra of substances similar in structure. Their ratio was established with a 91 % coincidence rate (Table 1).

Table 1: The results of a comparative analysis of the database Thermo Scientific IR spectrum of the initial sample of the rubber part (outer layer)

Components with a comparable spectrum	Ratio of components by spectrum, %	Coincidence, %
Polyamide resin	32,87	91,37
Acacia powder	41,68	
Polyethylene. High density	25,45	

The hardness study (Table 2) shows that after thermo-oxidative aging at 120 ° C, the hardness value increases. The samples were rigid, lost their elasticity, although they retained their shape.

Table 2: Values of hardness and elasticity of rebound samples of the intact rubber polymer part of the packer before and after exposure at 120 ° C for 24 hours

Indicators	Shore A hardness, conl.unit.		Rebound elasticity, %	
	Outer layer	Inner layer	Outer layer	Inner layer
Before aging	80	73	30	42
After aging	91	81	22	14
Aging coefficient	11	8	0,73	0,33

Conclusions

When hydraulic and mechanical packers are working, the load is distributed unevenly, which means that the strength of the packer is negatively affected. In swelling packers, the load is distributed evenly over the entire length of the swelling. While the length of the elastomer, i.e. the swelling sealing element is the main factor for the contact area, the longer the elastomer. The more pressure drops the swelling packer can perceive. One of the important factors in the work of partners is the duration of the packer itself. Hydraulic mechanical packers are activated immediately after the layout is lowered. The swelling packer acts gradually thereby providing long-term insulation of the Layers and protects the column from damage.

The damage to the rubber-polymer part of the packer obtained during the test was studied and an assumption was made about the possible causes of damage to the swelling packer. A combination of several factors could lead to damage to the packer during testing in the well:

- high temperature at the landing site of the packer, which could lead to deterioration of operational characteristics;
- a sharp pressure drop when pumping liquid into the packer through a column of tubing;
- high hygroscopicity of the rubber part of the packer, which could cause changes in the structure.

Samples of the rubber part of the packer before and after damage were studied by infrared spectroscopy. In the infrared spectrum of the damaged sample, an absorption band corresponding to the presence of free OH groups is observed. Infrared spectra of samples are analyzed in the built-in database. Substances with near infrared spectra have been determined. The influence of temperature on the physical and mechanical properties of the rubber part of the packer is studied. The change in hardness and elasticity of rebound after thermal aging was established. To prevent premature wear of the packer, it is recommended:
- include in the composition of the rubber part a reinforcing layer capable of withstanding a pressure drop, for example, a metal mesh
- more carefully select the operating conditions in the well, taking into account temperature, water and oil saturation, rock relief.

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АНАЛИЗ КОНСТРУКЦИИ НАБУХАЮЩЕГО ПАКЕРА И ИССЛЕДОВАНИЕ ПОВРЕЖДЕНИЙ УПЛОТНИТЕЛЬНОГО УЗЛА

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АННОТАЦИЯ

В статье приводится различительный анализ набухающих пакеров, используемые в разных странах, рассматривается классификация пакеров. Вкратце рассматривается принципы

функционирования как механических пакеров и гидравлических пакеров, так и набухающих пакеров, а также описывается их отличие в функционировании, времени раскрытии и времени выдержки относительно набухающих пакеров. Представляется преимущества набухающих пакеров перед другими пакерами. Описано превосходство и ключевые аспекты уплотнительных элементов, конкретно набухающих пакеров относильно механических и гидравлических пакеров, т.к. некоторые материалы резин входящихся в состав уплотнительного элемента обладает способностью к самовосстановлению герметизирующих свойств. Приводится этапы разработки, свойства эластомеров, который используются уплотнительного элементах пакера. Описывается защитные антиэкструзионные кольца, которая предохраняет уплотнительные узлы и элементы вдавливание эластомера. Даётся описание разновидностей набухающих пакеров, процесс набухания, преимущества недостатки набухающих пакеров. Анализировано повреждение резины уплотнительного узла, набухающего пакера впоследствии испытаний в скважине. С помощью различных методов испытана эластомер уплотнительного узла. Методом инфракрасной спектроскопии выявлен приблизительный тип материала и изменение в структуре. Определён изменения физикомеханических величин резины уплотнителя до и после термоокислительного старения. Определён прочность резинополимерной части пакера от воздействия агрессивных сред.
Ключевые слова: набухающий пакер, уплотнительный узел, элемент эластомера, повреждение, механический пакер, разрушение, гидравлический пакер, давление, температура.

ŞİŞƏN PAKERLƏRİN KONSTRUKSİYASININ ANALİZİ VƏ KİPLƏNDİRMƏ DÜYÜNÜNÜN KORLANMASININ TƏDQİQATI

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XÜLASƏ

Məqalədə müxtəlif ölkələrdə istifadə olunan şişkin paketlərin fərqli təhlili verilir, paketlərin təsnifatı araşdırılır. Həm mexaniki pakerlərin, həm də hidravlik pakerlərin, eləcə də şişən pakerlərin işləmə prinsipləri qısaca nəzərdən keçirilir və onların işləməsindəki fərq, şişən paketlərə nisbətən açılma və saxlanma müddəti təsvir olunur. Şişən pakerlərin digər pakerlərə nisbətən üstünlükləri təqdim olunur. Kipləndirmə elementini təşkil edən bəzi rezin materiallar sızdırmazlıq xüsusiyyətlərini öz-özünə bərpa etmək qabiliyyətinə malik olduğundan, mexaniki və hidravlik paketlərlə müqayisədə xüsusi olaraq şişən pakerlərin sızdırmazlıq elementlərinin üstünlüyü və əsas cəhətləri təsvir edilmişdir. İnkişaf mərhələləri, pakerin sızdırmazlıq elementləri tərəfindən istifadə olunan elastomerlərin xüsusiyyətləri verilmişdir. Qoruyucu anti-ekstruziya halqaları təsvir edilmişdir, hansılar ki, sıxlaşdırıcı elementləri qoruyur və onun qalığını

qabartmağa şərait yaradır. Həmçinin şişən pakerlərin növlərinin təsviri, şişmə prosesi, üstünlükləri və çatışmazlıqları göstərilmişdir. Daha sonra quyuda sınaqdan keçirilmiş şişmə qablaşdırıcının sızdırmazlıq qurğusunun rezin zədələnməsi təhlil edilmişdir. Müxtəlif üsullardan istifadə edərək, sızdırmazlıq qurğusunun elastomeri sınaqdan keçirilir. İnfraqırmızı spektroskopiya ilə materialın təxmini növü və quruluşdakı dəyişiklik aşkar edilmişdir. Termo-oksidləşdirici yaşlanmadan əvvəl və sonra möhür kauçukunun fiziki mexaniki dəyərlərindəki dəyişikliklər müəyyən edilmişdir. Pakerin rezin polimer hissəsinin aqressiv mühitin təsirindən gücü müəyyən edilmişdir.

Açar sözlər: şişən pakerlər, paker rezini, sıxlaşdırıcı düyün, elastomer elementi, zədələnmə, mexaniki paker, dağılma, hidravlik paker, təzyiq, temperatur.

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IMPROVING THE EFFICIENCY AND RELIABILITY OF OPERATION OF TURBO-GAS COMPRESSOR EQUIPMENT FOR PETROLEUM ASSOCIATED GAS COMPRESSION

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ABSTRACT

In recent years, the oil and gas and other industries have been increasingly used turbo-gas compressors (TGC). Prospects for use of TGC at compression stations (CS) is associated with their large motor resource, energy consumption and autonomy that do not require additional energy supply.

The present paper is devoted to the creation of booster compressor stations with high reliability to ensure uninterrupted operation that meets high standards. In this connection, the collection of associated low-pressure petroleum gas for compressing and transporting it to the shore was the most urgent task in the acute shortage of natural gas. The performed analysis of the literature published showed that a significant number of works were devoted to the problem of ensuring a high level of reliability of compressor units. At the same time, there are no statistical data on failures necessary for deep analysis, the reasons causing certain equipment failures have not been sufficiently studied.

This does not allow to provide the necessary level of reliability when upgrading the existing and designing new compressor units.

It also requires the solution of a number of other problems related to ensuring reliability at the stages of design and manufacture of units. When developing and creating a new generation of TGC at the design stage it is necessary to carry out appropriate calculations to ensure the future safe operation of CS. To carry out these calculations, it is necessary to develop new scientific approaches and mathematical models on the basis of which it is possible to obtain more reliable results about the behavior of TGC in future operation.

Similar calculations should be carried out for both existing and operating TGC in order to assess their suitability for work and to predict the life of the main working elements of TGC and CS in general.

Keywords: reliability, boost compressor stations (BCS), gas turbines, compressor units, operating time, failure.

The problem of providing the national economy of the republic with natural gas is one of the most important and urgent, requiring a scientifically based approach. Of particular importance are the tasks of rational consumption, reduction of losses, increase in efficiency and reliability of operation of equipment for compressing associated petroleum gas.

The State Program for the Development of the Fuel and Energy Complex in Azerbaijan, adopted in February 2005, became the most important initiative of the gas sector and defined goals and objectives for 2005-2015. One of the main problems of the gas industry in Azerbaijan is to find ways to improve the efficiency of gas production, processing and pipeline transport systems, taking into account the specifics of operating gas supply systems in difficult conditions.

“Solar” company is the world's leading manufacturer of industrial gas turbines with a capacity of 1-14.5 MW, centrifugal compressors for the transportation of natural and associated gas, as well as gas turbine driven compressor and generator sets and driven gas turbine units.

Compressor units include a gas turbine, one or more gas compressors installed in series, a microprocessor control system and all necessary auxiliary equipment.” Solar” company designs and manufactures its own gas turbines, gas compressors and turbine units in accordance with ISO 9001 certified quality management systems.

Gas turbines are manufactured to strict industry standards and are extensively tested using state-of-the-art facilities. Currently, Solar's activities are certified in accordance with the requirements of Det Norske Veritas (DNV) in accordance with the International Organization for Standardization (ISO) 9000 quality system standards (Fig. 1).

Solar gas compressors are used primarily for field compression, which leads to efficient performance, high reliability, durability, ease of maintenance, as well as special requirements for equipment design (Fig. 2) [1].

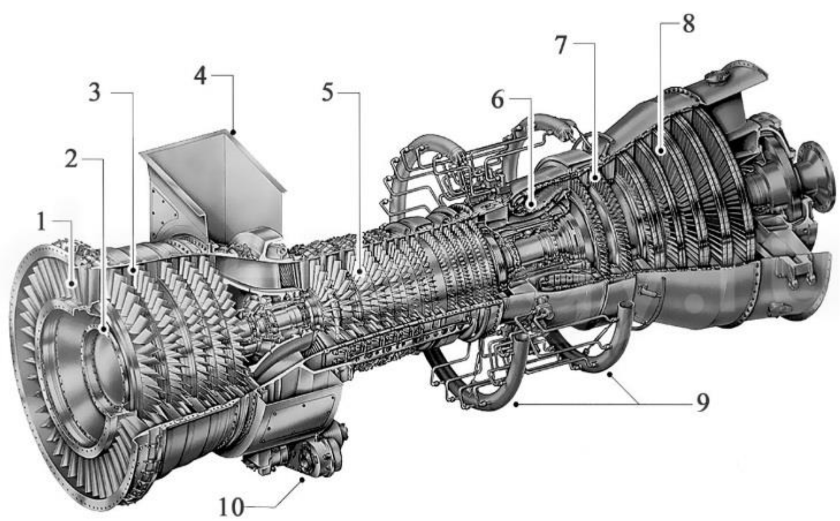


Figure 1: Typical gas turbine from “Solar”
1- inlet guide vane; 2- drive flange; 3- five-stage low pressure compressor; 4- bypass air collector; 5- fourteen-stage high pressure compressor; 6- combustion chamber; 7- two-stage high pressure turbine; 8- five-stage low pressure turbine; 9- pipeline for supplying fuel to the injectors; 10- auxiliary gearbox.

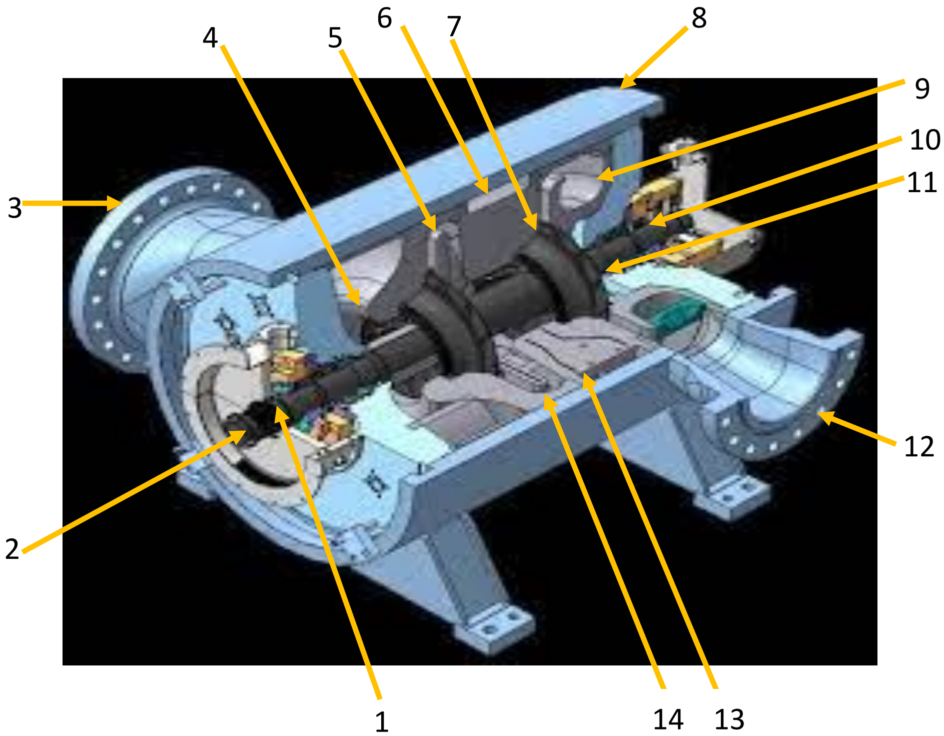


Figure 2:
Typical gas compressor of "Solar" company
1- bearing and seal assembly on the suction side; 2- connecting sleeve or balancing sleeve;
3- inlet flange (hole); 4- inlet guide vane; 5- suction channel; 6- stator assembly;
7- impeller; 8- housing; 9- discharge channel; 10- bearing and seal assembly on the pressure side; 11- unloading piston; 12- discharge flange (hole); 13- stator; 14- diffuser channel.

One of the main principles underlying the design of compressors is the interchangeability of all aerodynamic components within the overall frame dimensions [2]. At the same time, the main elements, such as the drive mechanism, coupling, bearings, seals, length and rotor supports are identical, and all parameters, such as temperature and pressure levels, are kept within the given design.
Thanks to this, the "configuration" of compressors can be easily changed to restore or improve performance and output-input ratio (OIR) when operating conditions may change significantly.
"Solar" company currently manufactures 11 Turbo Gas Compressor (TGC) models to meet a wide range of oil and gas applications and power requirements. Typical applications:
• Gathering gas at a well or collection point to a gas treatment station or booster compressor station.
• Increasing pressure from the well to a collection point, gas treatment station or booster compressor station.
• Storage/extraction for injection or extraction of gas in the gas storage by compressors for operation in series/parallel mode, allowing switching to different operating conditions.
• Transfer of gas from the gas pipeline with its inlet and outlet after the gas treatment station to the entrance to the gas distribution station.

• Re-injection of gas into the reservoir to maintain reservoir pressure or conservation.
• Gas lift - the injection of gas into an oil well to saturate the crude oil and facilitate its rise to the surface.
Issues on the design, development, operation of oil and gas fields, production, collection, treatment and transport of natural and associated gases are widely covered in [3, 4, 5, 6, 7, 8, 9, 10, 11, 12].
The ability of a TGC to fulfill the task of uninterrupted gas transportation is determined by its efficiency, which includes the technical perfection of the design and operational reliability [13].
The efficiency of TGC is determined by a set of properties that are set during design, are provided during manufacture and installation are supported during operation.
Operating experience shows that one technical perfection of the design is still not enough for the effective use of TGC. It is necessary that all the properties that form the technical excellence of TGC meet the specified reliability requirements [14].
The operation of a very technically complex and expensive facility, such as a compressor station built in the offshore oil field "Neft Dashlari", put forward several urgent problems in the forefront. Among the most important of them is the problem of ensuring, maintaining and increasing the level of reliability of the compressor station during operation. Since in the conditions of the Caspian Sea a compressor station (CS) of a gas turbine type was put into operation for the first time, there was no operating experience for this type of equipment, the nature of the influence of many regional, climatic, regime factors was unknown. Based on this, in order to improve the efficiency of operation, ensure and improve the reliability of the compressor station in local conditions, it was necessary to conduct extensive studies taking into account the influence of these factors. The specificity and nature of the operation of the booster compressor station for compressing associated petroleum gas implies continuity and a high degree of failure-free operation over a long calendar period, therefore it is obvious that in order to assess the reliability characteristics, it is necessary to clearly define and build probabilistic laws for the distribution of reliability, durability and maintainability indicators with the accumulation of an array of data on operating time and failures of components and assemblies as a whole [15, 16].
The Booster-Compressor station (BKS)-2 compressor station was equipped with 9 Centaur units, consisting of T-4500 gas turbines and S-307 compressors, of which only two compressors turned out to be new, while the rest of the engines and compressors were overhauled and restored after working out one and more than one resource.
On figure 3 shows a diagram of the Centaur 40 gas turbine compressor unit, which is installed at Neft Dashlari.
The gas turbine compressor unit (Figure 3) consists of the following components:

- Turbine dashboard
- Turbine air inlet
- Gas turbine
- Turbine exhaust
- Gas compressor
- Gas compressor dashboard

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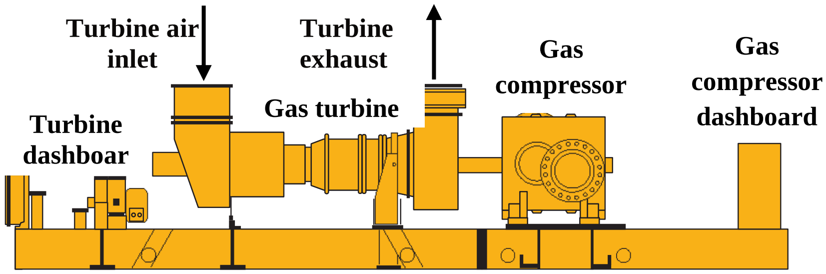


Figure 3: Scheme of the gas turbine compressor unit Centaur 40

Thus, in the field of forecasting, evaluating and improving the reliability of TGC, significant research has been carried out and the theoretical, practical and methodological foundations of this relatively new direction in science and technology have been developed. The main ways and means of increasing the efficiency of their use in various operating modes are analyzed. Methods for calculating and designing the main elements of the TGC are given, providing for the possibility of using computers and system of automated design CAD. The characteristics of mastered and promising materials for the manufacture of TGC parts are given. In the field of reliability of various systems, a lot of theoretical and applied research including oil and gas equipment has been carried out [11, 12].

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ПОВЫШЕНИЯ ЭФФЕКТИВНОСТИ И НАДЕЖНОСТИ ЭКСПЛУАТАЦИИ ТУРБОГАЗОКОМПРЕССОРНОГО ОБОРУДОВАНИЯ ДЛЯ КОМПРИМИРОВАНИЯ ПОПУТНОГО НЕФТЯНОГО ГАЗА

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РЕЗЮМЕ

В последние годы в нефтегазовой и других отраслях промышленности все более широкое применение получают турбогазокомпрессоры (ТГК). Перспективность использования ТГК на компрессорных станциях (КС) связана с их большим моторесурсом, энергоемкостью и автономностью, не требующей подвода дополнительной энергии.
Данная статья посвящена созданию дожимных компрессорных станций с высокой надежностью для обеспечения бесперебойной эксплуатации, отвечающей требованиям высоких стандартов. В связи с этим сбор попутного нефтяного газа низкого давления для компримирования и транспортировки его на берег являлось актуальнейшей задачей при остром дефиците природного газа. Выполненный анализ опубликованных литературных источников показал, что проблеме обеспечения высокого уровня надежности компрессорных агрегатов посвящено значительное число работ. В то же время отсутствуют, необходимые для глубокого анализа, статистические данные об отказах, недостаточно изучены причины, вызывающие те или иные отказы оборудования.
Это не позволяет при модернизации существующих и проектировании новых

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компрессорных агрегатов обеспечить необходимый уровень их безотказности. Требует также решения и ряд других задач, связанных с обеспечением надежности на этапах проектирования и изготовления агрегатов.

При разработке и создании нового поколения ТГК, на стадии проектирования необходимо проведение соответствующих расчетов, обеспечивающие будущую безопасную эксплуатацию КС. Для проведения этих расчетов необходимо разработать новые научные подходы и математические модели, на основе которых можно получить более достоверные результаты о поведении ТГК в будущей эксплуатации. Подобные расчеты нужно провести как для уже существующих, так и для находящихся в эксплуатации ТГК, с целью оценки их пригодности к работе и для прогнозирования ресурса основных рабочих элементов ТГК и КС в целом.

Ключевые слова: надежность, дожимные компрессорные станции (ДКС), газовые турбины, компрессорные агрегаты, наработка, отказ.

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DEVELOPMENT OF RECOMMENDATIONS FOR IMPROVING THE INSTALLATION SUITABILITY OF PUMPING UNITS USED IN THE REPAIR AND RESTORATION WORK OF WELLS

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ABSTRACT

Oilfield pumping units are often subjected to a periodic full cyclein the performance of technological operations, namely: transportation., installation, operation of equipment and dismantling, for transportation and repetition of the entire cycle. For equipment located on mobile vehicles, periodic installation is characteristic.
At the same time, during the installation of oilfield equipment, deviations from technical conditions are characteristic, which lead to accelerated failures, their reliability and resources decrease.
To ensure a high level of installation suitability, it is required to have a specific concept, which is the concept of installation suitability.
The purpose of the work is to develop recommendations for improving the installation suitability of pumping units used in the repair and restoration work of wells.
Based on the results of the work carried out, it was concluded that the suitability for installation and manufacturability of installation are among the important indicators of processing oil and gas field equipment, significantly affecting reliability, labor productivity during maintenance, current and aggregate-node repairs; operating costs and efficiency of equipment use.
Keywords: installation suitability, testing, production, indicator, oilfield equipment.

Relevance of the work

Onshore oil deposits in Azerbaijan are at the last stage of their development, where the level of productionand oil is falling every year, and the number of repair and restoration operations is increasing. If 30 years ago the oil flow rate was 20 tons, today this value is 0.7 tons. and the degree of mineralization of the reservoir. as well as the intensity of the formation of sand plugs.
During the repair and restoration work of the well, a complex of equipment is used, including pumping units and other technological meansa. Analysis of the main causes of pumping unit failures shows that the most vulnerable unit is the oilfield pump.
Pumping units, according to their functional purpose, are subject to frequent installationand dismantling of the u. Therefore, the main requirements imposed on this equipment is high installation and suitability.
Based on the foregoing, the purpose of the work can be formulated as follows.

The purpose of the work

Development of recommendations to improve the installationandsuitability of pumping units used in the repair and restoration of wells.

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The results of the study and their discussions

Installation suitability is a property of the equipment characterizing its ability to assemble.

The installation of most oilfields is equipped is very costly in terms of labor intensity and material concepts.

Installation of equipment is a continuation of the process of manufacturing equipment, since operation follows immediately after installation. The very concept of installation suitability consists of two steps: Installation of the equipment itself at enterprises, plants andontage equipment at the place of its operation

The quality of installation depends on various factors, from design to the skill of the installation contractor at the facility of operation.

Depending on the functions performed by the equipment, there are also types of installation. As mentioned earlier, oilfield equipment is characterized by periodic, repeated installation and dismantling of equipment. For most equipment that is operated outdoors, stationary installation is characteristic. This installation often occurs once, dismantling is carried out mainly when transferring to the reserve or writing off the equipment.

Oilfield pumps type 5 H-160 as part of a pumping unit, used in oil and gas producing regions, for various types of operations. One of the main operations is cementation. When cementing a well, a scheme for the distribution of cementing equipment is used. The functional scheme is usually divided into a number of subsystems that are connected to the wellhead by means of a manifold.

The effectiveness of the cementation process directly depends on the layout of the equipment. Actively used strapping schemes at the moment is considered to be Table 1. Symbols of equipment in the diagram: "pumping units-mouth" (conventional numbers 1 and 2); "pumping units-block manifold-mouth" (conventional numbers 3, 4, 5 and 6); "pump units-average capacitance-manifold block-mouth" (conventional numbers 7 and 8).\

Table 1: Composition of cementing equipment [1]

Conditional numbers of accepted strapping schemes	Number of equipment used					
	Pumping units*	Cement mixing plants	Manifold block	Averaging capacity	Spare	
					Pumping units	Cement mixing plants
1 (fig.1)	3	2	-	-	1	-
2 (fig.2)	5	2	-	-	2	-
3 (fig.3)	5	2		-	2	-
4 (fig.4)	13	6	1	-	5	-
5 (fig.5)	8	3	1	1	3	1

The listed typical strapping schemes of the characteristic arrangement of cementing equipment are shown in Figure 1-5.

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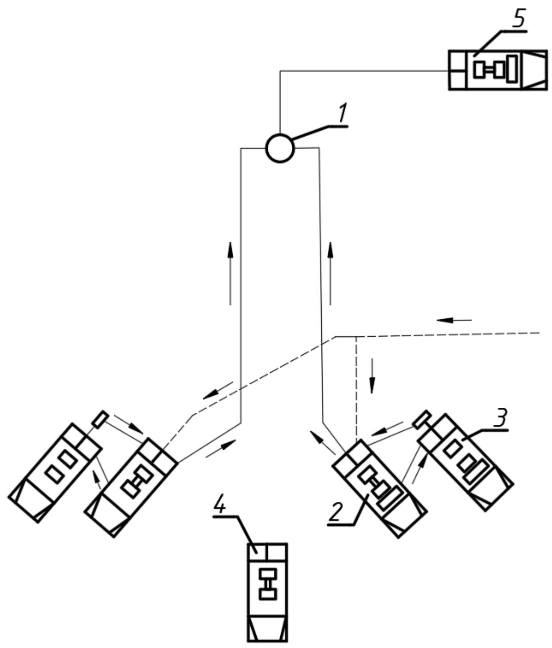


Figure 1: Scheme of strapping of installations when cementing conductors and shallow intermediate columns:1 - well; 2- pump unit; 3 - mixing plant; 4 - backup pump unit; 5 - pumping unit, involved in the sale of the separation plug.

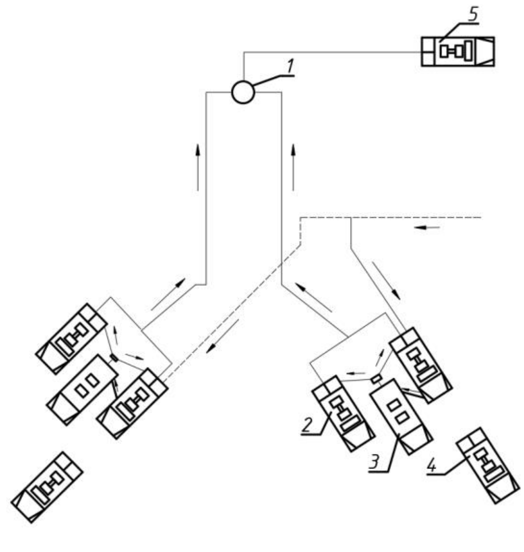


Figure 2: Wiring diagram of installations when cementing wells using 20... 40 t oil-well material 1 - well; 2 - pumping unit; 3 - mixing plant; 4 - backup pump unit; 5 - pumping unit, designed for pushing the separating plug.

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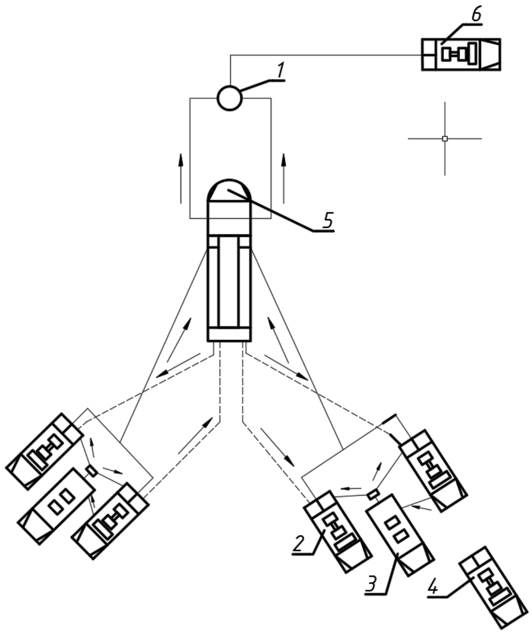


Figure 3: Scheme of strapping of installations when cementing wells using a manifold block
1 - well; 2 - pumping unit; 3 - cement mixing plant; 4 - backup pump unit; 5 - manifold block;
6 - pumping unit designed for pushing the separating plug.

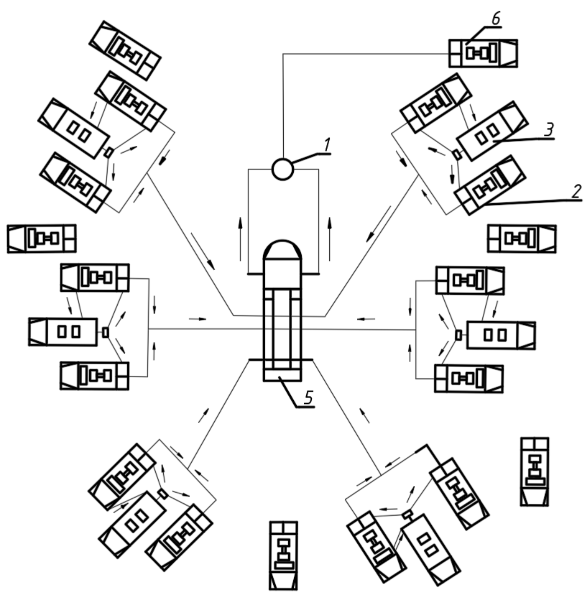


Figure 4: Scheme of strapping of installations when cementing deep wells
1 - well; 2 - pumping unit; 3 - cement mixing plant; 4 - backup pump unit; 5 - manifold block;
6 - pumping unit designed for pushing the separating plug.

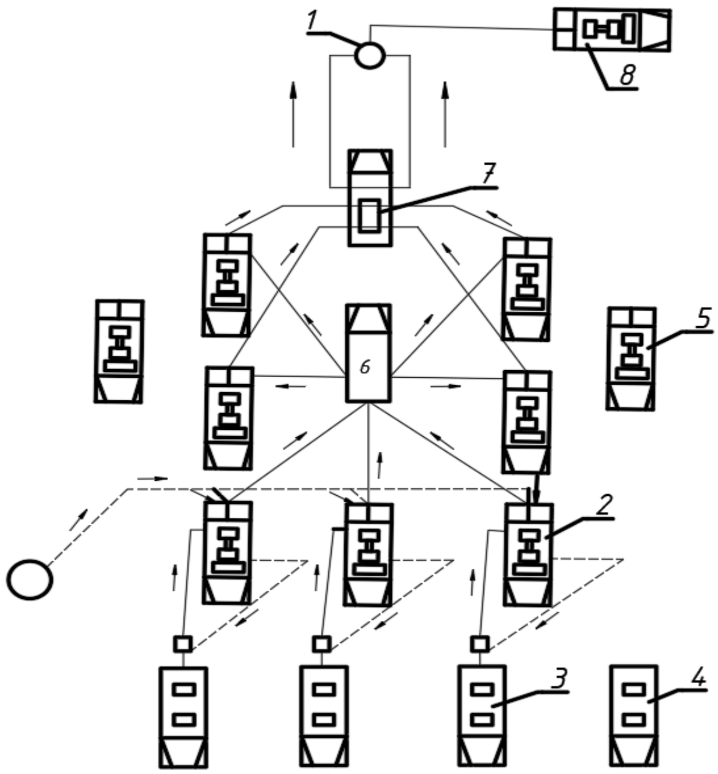


Figure 5: Scheme of strapping of installations when cementing deep wells using a manifold block and an averaging tank.

Analysis of the purpose and functional composition given in Table 2 typical schemes of strapping equipment for cementing wells show that their use is associated with periodic installation (dismantling) work, differing in labor intensity and scope of work.

Figure 3 shows the initial data for regression analysis: the structural mass of the strapping elements, overall dimensions, the number of fasteners used in the installation of equipment, the number of assembly units. At the same time, the dependent variable (difficulty of installation) through , and the factors-arguments: through , through , through , through , through [2] are indicated G L $n_{д}$ N $T_{мi}$ y_i G x_1 L x_2 $n_{д}$ x_3 N x_4.

Based on the data of Table 3 , the regression coefficients are determined and equations characterizing the relationship of the labor intensity of installation of strapping cementing equipment with [$T_{м}$ 2] are obtained:

- structural mass of strapping elements

$$T_{м} = 0{,}35G - 190{,}0; \quad (1)$$

- strapping length

$$T_{м} = 66{,}22L^{0{,}40}; \quad (2)$$

- Numberoffasteners

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$$T_м = 2{,}68 n_д - 64{,}80; \tag{3}$$

- number of assembly units

$$T_м = 8{,}85 N - 35{,}70; \tag{4}$$

Table 2: Resource requirements by component. Data for determining regression coefficients

Conditional strapping scheme numbers	Structural mass of elements (kg), G	Strapping length (m), L	Number of fasteners, $n_д$	Number of assembly units, N	Complexity of installation (person-ch.), $T_{мi}$
1 (fig.1p)	12200	33	114	28	230
2 (fig.2p)	14800	56	142	39	320
3 (fig.3p)	16600	74	176	50	390
4.	20200	167	220	60	510
5.	23800	285	260	77	630
6 (fig.4p)	26000	405	292	85	720
7.	28000	506	320	98	790
8 (fig.5p)	31800	695	372	112	910
$\sum$	173400	2221	1896	549	4500

Along with this, by means of multivariate correlation analysis, a regression equation was obtained between the complexity of installation and the design characteristics of the strappings.

$$T_м = -21{,}9550 + 0{,}01053\, G + 0{,}5805\, L + 1{,}0494\, n_д - 0{,}7818\, N\,. \tag{5}$$

In this case, the found value of the coefficient of determination is:
$Д = (R_{yx_1x_2x_3x_4})^2 = 0{,}998$; This means that the labor intensity of installation of strapping cementing equipment by 99.8% depends on the number of assembly units and parts, the number of fasteners, the length of the strapping, the structural weight of the elements and only 0.2% of the unaccounted factors.

By analogy with the term "complexity repair" used in many industries [3], to assess the complexity of installation work, it is advisable to take the term "installation complexity of equipment", and as a normative indicator of installation complexity - the category of complexity of installation. The more complex the equipment, the greater its main dimensions (mass) and other structural and technological parameters, the higher the category of installation complexity of the equipment.

It is especially important to assess the installation complexity of the equipment during repeated installation and dismantling works due to the periodic transfer of equipment from one point to another.

The category of complexity of equipment installation is determined by the ratio of the labor intensity of installation work to the conditionally chosen labor intensity of the unit of the complexity category. Therefore, taking a single value and having data on the actual value for

various sizes or models of equipment, it is possible to estimate the categories of complexity of their installation by the indicator $R_м$ $T_м$ $H_м$ $H_м$ $T_м$ $R_м = T_м / H_м$.
The value can be taken according to the recommendations of the work [$H_м$ 3] equal to 60 people-hours. (assigned to the 4th category of fitters for equipment repair).
For the possibility of assessing at the design stage the category of complexity of installation, it is also necessary to identify the most significant ones from the totality of the listed constructive and technological factors, to determine the form of the correlation between them, depending on their quantitative values.
First, the closeness of the correlation relationship between each of the parameters under consideration separately is determined. To do this, empirical values of correlation coefficients are calculated $R_м$ r_{xy} , taking into account the sample values of the parameters given in Table 2. Then, to determine the analytical relationship between the factors under study, the method of multiple correlation is used [4]. It is assumed that there is a linear form of connection between the category of installation complexity and the factors that cause this random variable $R_м$

$$y = a_0 + a_1 x_1 + a_2 x_2 + a_3 x_3 + a_4 x_4 . \tag{6}$$

Estimates of unknown parameters , a_0 a_1, , , a_2 a_3 a_4 from a sample of known values , , and are found by the method of least squares based on the requirement: G_i L_i n_i N_i $(i = 1, 2, ..., m)$

$$\sum_{i=1}^{m} \left| y_i - (a_0 + a_1 x_1 + a_2 x_2 + a_3 x_3 + a_4 x_4) \right| = \min , \tag{7}$$

where is the number of strapping schemes studied; m $m = 8$.
To identify the existence of a systematic stability of the relationship between the considered features, the criterion of the independence of signs was used [$\hat{T}$ 5], the value of which is determined by the formula

$$\left| \hat{T} \right| = \frac{r_{xy} \sqrt{m-2}}{\sqrt{1 - r_{xy}^2}} \geq t_{\alpha.k} , \tag{8}$$

where is the coefficient of pair correlation; r_{xy}
$k = m - 2$ - the number of degrees of freedom;
$t_{\alpha.k}$ - The limit value of a random variable , satisfying the Student's distribution. T
Calculations performed (Table. 2) showed the existence of a systematic relationship between the category of installation complexity and the parameters , , and $R_м$ G L $n_д$ N [6].
According to the tabulated data of the Student distribution, at the accepted level of significance and the number of degrees of freedom, we find a critical value $\alpha = 0{,}05$ $k = 6$ $t_{\alpha.k}$ of = 2.447. As can be seen, the observed values (see Table 3) far exceed the tabulated value, which indicates the existence of a stable relationship between the features under consideration. $\left| \hat{T} \right|$ $t_{\alpha.k}$

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As a result of the calculation of numerical values of unknown parameters from condition (7), the following values of the coefficients were obtained:

$$a_0 = -3{,}008;\ ;\ ;\ ;\ .\ a_1 = 0{,}00038\, a_2 = -0{,}00044\, a_3 = 0{,}0311\, a_4 = -0{,}0452$$

Table 3: Resource requirements by component. Criteria for the independence of a feature.

Structural and technological parameters of the equipment	Pair correlation coefficients r_{xy}	Values of the criterion of the independence of the feature $\lvert\hat{T}\rvert$
G	0,991	44,31
L	0,964	28,94
$n_д$	0,989	40,01
N	0,988	38,27

Thus, the regression equation taking into account the accepted notations is of the form

$$R_м = -3{,}008 + 0{,}00038\, G - 0{,}00044\, L + 0{,}0311\, n_д - 0{,}0452\, N\ . \quad (9)$$

Comparison $R_м$ of values calculated by formula (9) with empirical values (see Table 9). 3) showed a good coincidence.

The described method for determining the empirical dependence for assessing the category of complexity of equipment installation is also applicable with the simultaneous impact of a larger number of factorial features. $R_м$

Table 3: Resource requirements by component

Conditional strapping scheme numbers	Category of installation complexity	
	Actual $R_м = \dfrac{T_м}{H_м}$	Calculated (according to formula (6.24))
1	3,83	3,89
2	5,33	5,24
3	6,50	6,48
4	8,50	8,72
5	10,50	10,51
6	12,00	11,93
7	13,17	12,93
8	15,17	15,28
$\sum$	75,00	74,98

Conclusion

Thus, installation suitability and installation manufacturability are among the important indicators of the processing of oil and gas field equipment, significantly affecting the reliability, labor

productivity during maintenance, current and aggregate-node repairs; on operating costs and efficiency of use of equipment.

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РАЗРАБОТКА РЕКОМЕНДАЦИЙ ПО ПОВЫШЕНИЮ МОНТАЖАПРИГОДНОСТИ НАСОСНЫХ УСТАНОВОК ПРИМЕНЯЕМЫЕ ПРИ РЕМОНТНО-ВОССТАНОВИТЕЛЬНЫХ РАБОТАХ СКВАЖИН

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РЕЗЮМЕ

Нефтепромысловые насосные установки часто подвергаются периодический полный цикл выполнения технологических операций, а именно: транспортировка, монтаж, эксплуатация оборудования и демонтаж, для транспортировки и повтора всего цикла. Для оборудований находящиеся на передвижных автомобилях, характерен периодический монтаж.
Одновременно при монтаже нефтепромысловых оборудований свойственно отклонения от технических условий, которые приводят к ускоренным отказам, снижается их надёжность и ресурсы.
Целью работы является разработка рекомендаций по повышению монтажапригодности насосных агрегатов, используемых при ремонтно-восстановительных работах скважин.

По результатам проведенной работы был сделан вывод о том, что пригодность к монтажу и технологичность монтажа относятся к числу важных показателей обработки нефтегазового промыслового оборудования, существенно влияющих на надежность, производительность труда при техническом обслуживании, текущем и агрегатно-узловом ремонтах; эксплуатационные расходы и эффективность использования оборудования.

Ключевые слова: монтажепригодность, нефтепромысловые насосные установки, производство, показатель надежности,

QUYULARIN TƏMİR VƏ BƏRPA İŞLƏRİNDƏ İSTİFADƏ OLUNAN MƏDƏN NASOS QURĞULARININ MANTAJA YARARLIĞININ ARTIRILMASI ÜÇÜN TÖVSİYƏLƏRİN İŞLƏNMƏSİ

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XÜLASƏ

Neft-mədən nasos qurğuları tez-tez texnoloji əməliyyatları dövrndə nəqliyyat, avadanlıqların quraşdırılması, işə salınması və yenidən demantaj olması, təkrar daşınmya məruz qalır.

Bununla yanaşı, neftmədən nasos qurğuları istismar prosesidə imtinalara uğrayırlar. Bu isə onların etibarlılığının və resurslarının azalmasına gətirib çıxarır.

İşin məqsədi. quyuların təmir və bərpa işlərində istifadə olunan neftmədən nasoslarının montajayararlığının artırmaq üçün tövsiyələr işlənməsidi.

Görülən işlərin nəticələrinə görə, montajayararlılıq və təmiristehsal qabiliyyəti, etibarlılığı, texniki xidmət zamanı əmək məhsuldarlığına, cari və kapita təmirini müddətinə əhəmiyyətli dərəcədə təsir edir, istismar xərcləri və avadanlıqdan istifadənin səmərəliliyi artmasına əsas yaradır.

Açar sözlər: neftmədən nasos qurğusu, sınaq, etibarlılıq göstərici, neft-mədən avadanlıqları.

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QUALITY STUDIES OF PLASTIC PARTS OILFIELD EQUIPMENT

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ABSTRACT

The article considers the quality of plastic parts of oilfield equipment depending on the modes of manufacturing their various designs and the composition of press materials. By adjusting the regime parameters in the manufacture of parts, quality indicators are determined: tensile strength, hardness of parts, and others. The use of parts made of plastic materials for the development of the oil field equipment industry can be considered efficient from a technical and economic point of view. Also, in order to improve the quality, strength and longevity, plastic masses, which are an alternative product to metals and non-metals, have started to be used. Studying the performance indicators of the used plastic materials is considered mandatory. The quality of details made of plastic masses depends on many factors, and the indicators of these factors appear during operation. The quality indicators of products made of plastic materials in oil field equipment are distinguished by the presence of unlimited possibilities, greater than structural materials. Parts made of such materials have high performance indicators and are used in the preparation of parts with different constructions using uncomplicated processing methods. For the development of the oil industry, ways to increase the durability and longevity of the equipment used in this industry should be investigated. Based on the results, an experimental-theoretical method for determining the main quality criteria (shrinkage deformation and other quality indicators, strength, hardness, surface roughness) of plastic parts is proposed. The developed technique for the design of plastic parts makes it possible to estimate the expected life of parts, taking into account their operating conditions.
Keywords: quality, plastic parts, press materials, performance, shrinkage.

Introduction

Plastic masses, synthetic resins, and polymers are widely used in the oil industry. If we want to increase the quality indicators of machines and equipment, it is considered necessary to increase the quality of each of its parts. In order to exceed these indicators, synthetic resins, polystyrene, epoxy, plastic glass, polymer and its types are widely used in the oil and gas industry. It is possible to take almost any shape from plastics, the product obtained by molding does not need additional processing in terms of size and surface quality. As less heat is needed during processing, energy consumption is lower. Since it is processed with low heat, it is easier to undergo processing processes [1].

In the last 50 years, the production of products from plastic materials has taken the place of many products with rapid spread. For example, we can say that the parts produced in metal are already obtained from plastic materials. The total volume of polymers used today is greater than metals. Due to its low density, it has a lighter weight than metals.

The characteristics of details made of plastic materials show themselves during operation, increasing their reliability, longevity and durability.

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The precision quality of machined parts is higher than the precision quality of parts produced by pressing and casting. Therefore, it is possible to bring the parts obtained by pressing and casting to a more precise quality by subsequent mechanical processing.
The low accuracy quality of the parts obtained from plastic materials can be considered its main problem. So, making a plastic part by mechanical means is a difficult process. The fact that the top layer cannot be cut well during processing is a factor that leads to the loss of its material. It shows the problem of not being able to obtain accurate dimensions and not being able to ensure the strength of the parts produced by plastic materials during the service life.

Purpose of the study

During the development and production of equipment, its quality and longevity varies depending on the quality of each part of its details.
Taking into account the constructive, technological and operational factors, we can achieve better quality of parts made of plastic materials. We can improve the quality of oil field equipment based on constructive methods by increasing friction resistance.
While ensuring that oil equipment is made of plastic materials, we can increase its durability by improving operational performance. Details made of plastic materials are widely used and can take their place in the world's oil industry with the increase in production volume [2].

Methodical base of the study

A plastic material with a high molecular organic basis takes a solid fluid state under the influence of pressure and temperature. After solidification, they are materials that can take shape during processing and keep that shape. Plastics are classified according to operational technology and application areas. In addition, depending on the purpose of use, additional additives are added to plastics with different properties. Therefore, additives have an almost necessary place in the sector of plastic materials.

Table 1: Mechanical and physical properties of some thermosetting materials

№	The name of the material	Epoxy resin	Polystyrene	Phenol
1	2	3	4	5
1	density (kg/m³)	1,11	1,04÷1,46	1,24÷1,32
2	Modulus of elasticity (MPa)	7000	3400	4800
3	Tensile strength (MPa)	70	41÷90	34÷62
4	Elongation (%)	3÷6	42	1,5÷2,0
5	Thermal conductivity	0,19	0,19	0,15
6	Coefficient of thermal expansion (1 / ° C)	45÷65	55÷100	68

In the oil and chemical engineering industry, products made from polymer materials can be cited as many detailed examples. For example, we can show caps, stacks, grooves, flanges and other parts. Thus, the rings made of plastic materials are made according to the surface of the cylinder, a mold is formed, and compression of the piston and piston is ensured. Hermetic seal reduces leakage,

increases compressor efficiency by 3-5%. Also, the working temperature of the compressor is better compared to the part made of metals.

If the turbines working in the oil field equipment are made of thermoplastic material, according to the results obtained from the tests of washing solutions and mechanical loads, the phenomenon of intensive corrosion due to the effect of high temperature will be observed. As a continuation of this process, physical-mechanical properties and geometric dimensions will change [3].

Turbines made of polymer material tend to fail quickly as a result. In drilling pumps and compressors, it is possible to prevent pressure rise by using a safety valve. The main parameters of the thickness accuracy in the joint parts are used to ensure the stability of the pressure of the destructive valve.

Couplings used in machine parts are subject to a lot of damage, so friction and other damage can occur on the edges of the couplings. This can lead to loss of firmness and elasticity. In order to reduce this relatively, the teeth connecting in gear couplings are made of plastic materials. Although the use of plastic materials is more efficient, it is impossible to make the couplings entirely from plastic materials, in couplings made of metals, plastic masses are used as reinforcement.

The UMB-250 sealing ring of the manifold made of polyethylene works in medium pressure and aggressive environments. The working temperature range is 400C - 1200C, and the pressure limit is equal to 12 MPa. The operating conditions of sealing rings mean ensuring the cleanliness, high-precision size, and required hardness of their connecting surface. The fit between the piston and the cylinder made of these materials is better.

Piston rings made of АФГМ material can work up to 5000 hours installed in 2CQ-50 type compressors, while they work up to 3000 hours when they are made of F4-10 material. But if the piston rings were made of metal, they could work up to 2000 hours Piston rings made of plastic materials are manufactured using AFQM or F4-10 materials. in the same environment. One of the causes of malfunction of the piston is a violation of the seal between the piston and the cylinder, as a result of which leakage occurs and the piston loses its productivity and power. As a result, the proper operation of the compressor is disturbed [4].

It is important to reduce the thickness of the walls in order to avoid accumulation during cooling and to reduce the internal stress for the parts made of plastic materials, mainly made of thermoactive materials. When reducing the thickness of the walls of the parts, it opens the way for the identification of all thicknesses, it affects the quality in the selection of the same modes in their preparation. At this time, we observe an increase in the quality of parts.

The process by which thermosetting polymers can be recycled is different from thermoplastics. Recycling in the use of these materials can be considered an irreversible process. Thermosetting materials may not soften even at high temperatures compared to thermoplastic materials. After obtaining the material, it is frozen for parting, as a result of which it is possible to prevent its hardening.

After hardening, the material can already be stored. Frozen material, after waiting for 1-4 weeks after removal, leads to hardening and loss of quality. Taking this into account, the part that we will make from thermoset material should be prepared during this period. The storage period varies from 6 to 18 months by freezing. Thermosetting resins are resistant to chemical effects depending on the environmental conditions, and also have a longer life compared to other plastic materials, taking into account various thermal effects [5].

Epoxy resin: Their fields of application are wide. Reasons for its widespread use: good mechanical properties; the presence of high resistance; up to 140 C ° in the wet case; heat resistance up to 220 C ° in dry state; low shrinkage in the hardened state; they are stable in chemical environments. Disadvantages: they are expensive; may be harmful during preparation; they require a lot of attention when adding mixtures.

Discussion of the obtained results

Let's take a look at the experimental results:

1. As the temperature rises, the distortion of the dimensions of both the press-mold and the cylinder becomes sharper, thereby causing shrinkage deformation in the material.
2. With the increase of pressure, there are disturbances in the measurement of the casting process.
3. As a result of increasing the aggregation deformation, the property of free aggregation increases during cooling.
4. Due to the thermal expansion of the composition of the assembly, the composition decreases.

Considering all the researches, research works are currently being carried out to improve the properties of parts made of plastic materials, to increase the strength of parts made of plastic mass, as well as to study the level of accuracy.

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NEFT MƏDƏN AVADANLIQLARINDA PLASTİK KÜTLƏDƏN OLAN HİSSƏLƏRİN KEYFİYYƏTİNİN TƏDQİQİ

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XÜLASƏ

Məqalə neft mədən avadanlıqlarında işləyən plastik kütlədən olan hissələrin keyfiyyətlərinin öyrənilməsinə həsr edilmişdir. Hal-hazırda etibarlılığın, uzunömürlülüyün və neft istehsalı avadanlığının effektivliyinin artımı üzrə əhəmiyyətli istiqamətlərdən biri əlvan və qara metalların əvəzinə yeni yüksək davamlı materialların, xüsusi halda plastik kütlələrin tətbiqidir. Plastik materialların keyfiyyəti başqa konstruktiv materiallarla müqayisədə onu göstərir ki, onlar qeyri-məhdud imkanlara malik materialdır. Əsas keyfiyyət göstəriciləri olan sıxılmada möhkəmlik, bərklik, səthin kələ-kötürlüyü, sıxlıq və yığışma deformasiyası neft-mədən avadanlıqlarında işləyən plastic detalların üzərində geniş öyrənilmişdir. Texnoloji rejimlərin detalların keyfiyyət göstəricilərinə təsirinin fiziki-mexaniki mənası analiz olunaraq, bu göstəricilərin bir-biri ilə əlaqəsinin keyfiyyət baxımından dürüstlüyü axıra çatdırılmışdır. Neft istehsalı avadanlığının düyünlərində işləyən plastik detalların konstruktiv xüsusiyyətlərinin analizi və istismar şərtlərinin spesifikası göstərir ki, onlara yalnız tətbiq edilən əsas səbəb ağır istismar şəraiti deyil, neft maşınqayırmasında plastik kütlələrin tətbiqi sahəsində elmi-tədqiqat axtarışların məhdudluğudur.

Açar sözlər: keyfiyyət, plastik detallar, press materiallar, istismar göstəriciləri, yığışma deformasiyası.

ИССЛЕДОВАНИЯ КАЧЕСТВА ПЛАСТМАССОВЫХ ДЕТАЛЕЙ НЕФТЕПРОМЫСЛОВОГО ОБОРУДОВАНИЯ

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РЕЗЮМЕ

В статье рассмотрено качество пластмассовых деталей нефтепромыслового оборудования в зависимости от режимов изготовления их различных конструкций и состава пресс-материалов. Регулируя режимные параметры при изготовлении деталей определяются показатели качества: прочность при растяжении, твердость деталей и другие. Использование деталей из пластмасс для развития промышленности нефтепромыслового оборудования можно признать эффективным с технико-экономической точки зрения. Также для повышения качества, прочности и долговечности стали использовать пластические массы, которые являются альтернативой металлам и неметаллам. Изучение

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эксплуатационных показателей используемых пластиковых материалов считается обязательным. Качество деталей из пластических масс зависит от многих факторов, и показатели этих факторов проявляются в процессе эксплуатации. Качественные показатели изделий из пластмасс в нефтепромысловом оборудовании отличаются наличием неограниченных возможностей, больших, чем у конструкционных материалов. Детали из таких материалов имеют высокие эксплуатационные показатели и используются при изготовлении деталей различной конструкции несложными методами обработки. Для развития нефтяной промышленности необходимо исследовать пути повышения стойкости и долговечности оборудования, используемого в этой отрасли. На основании результатов предложен экспериментально-теоретический метод определения основных критериев качества (усадочной деформации и других показателей качества, прочность, твердость, шероховатость поверхности) пластмассовых деталей. Разработанная методика при конструировании деталей из пластмасс позволяет оценить ожидаемый ресурс деталей с учетом условий их эксплуатации.
Ключевые слова: качество, пластмассовые детали, пресс-материалы, эксплуатационные показатели, усадочная деформация.

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INVESTIGATION OF THE SEALING UNIT OF THE ANNULAR PREVENTER

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ABSTRACT

In this article, different kinds of sealing aspects for something like an annular тpreventer are looked at. It was looked at how spherical and cone-shaped sealing elements are made. The advancement of spherical seals has been looked into based on what other countries were doing. The sealing parts that are presently used for spherical circumferential preventers aren't really universal and only work with a small number of drill pipes. They also can't completely seal the well mouth when there are no drilling tools in the well. A seal for a annular-type preventer is considered. The sealer includes a large number of metal inserts embedded in the elastomeric body. The inserts are arranged radially at equal distances from each other around the longitudinal axis of the seal. They support the elastomeric body under radial compression, which ensures the sealing of the annular space. When the sealing assembly is compressed around the drill pipe, the elastomeric body is compressed radially in the direction of the longitudinal axis. Metal inserts move in the same direction. The disadvantage of this design is that in the closed position, the pressure in the borehole can affect the elastomeric body, which leads to a change in its stress state. As a result, significant stresses develop in certain areas of the elastomeric body, acting on the sealing assembly in two directions: radially to the center and along the longitudinal axis upwards. At significant pressures of the reservoir fluid, stresses can lead to the destruction of the seal. An annular sealing element placed between the lid and the plunger of a spherical annular preventer has been studied. The element is installed in the spherical cavity of the lid and consists of an elastic material reinforced with rigid inserts. This design has a disadvantage associated with the wear of the working surfaces. When the tool is axially moved through a closed sealing element, a narrow belt of elastic material near the inner upper edge of the sealing element first wears out. Then, as it wears out, the width of the belt increases, reaching full height at the end.
Keywords: circular sealing element, cylindrical sealing element, strengthened metal inserts, elastomeric body, annular preventer.

Introduction

The universal preventer is designed to increase the reliability of sealing the wellhead. Its main working element is a powerful annular elastic seal, which, when the preventer is open, allows the drill pipe column to advance, and when closed, it is compressed, resulting in the pipe being compressed and the annular area in between drill and casing strings being sealed by the rubber seal. The elasticity of the rubber seal allows you to close the preventer on pipes of various diameters and on locks. Universal preventers are designed to provide the ability to rotate and reciprocate (walk) the column with a sealed annular gap.

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The design and functions of the annular seal

The device is designed to seal the space between the inner diameter of the column head and the outer diameter of the suspended casing pipe or tubular element. The Annular seal is compressed either as a result of the impact of hydraulic force on the sealing element, or because of the effect of this force on the seal through a special annular piston [1].

The Annular seal must provide the following operations:

• moving columns up to 2000 m long with locks or couplings with conical chamfers at an angle of 18°;
• pacing and turning the column;
• multiple opening and closing of the preventer.

Seals — these are massive rubber annulars reinforced with metal inserts that give rigidity and protect against the development of deformations of the flow of rubber during operation. The seals in question comply with the technical specifications of TU 38 105562-78 and API 16A [2].

Currently, two types of sealing elements for universal preventers are most widely used — conical and spherical. Spherical seals, compared with conical seals, have less wear during axial movement of the pipe column with locks and provide guaranteed closure in the absence of a pipe column.

Design features of the conical seal:

• increased safety of the preventer at high pressures (70 MPa and above);
• flexibility of technological operations;
• easy maintenance;
• the built-in heating chamber of the working area of the sealer allows you to operate the preventer in the cold;
• it is possible to manufacture in a corrosion-resistant version to hydrogen sulfide [3].

The main parameters determining the efficiency of the sealing element:

• piston stroke;
• outer diameter of the seal at the starting point;
• the height of the seal along the rubber section at the starting point;
• armature height;
• the volume of the seal at the starting point;
• total volume of armature;
• volume of rubber;
• the smallest volume of the working cavity;
• weight of rubber.

Recently, the most promising in Russia and abroad are spherical annular preventers, for example, supplied by the domestic company Intera. Let's look at the top factors throughout modernizing spherical seals by looking at patent documents from the Russian Federation and the United States [4-7].

The source talks about an annular sealing aspect that goes between a spherical annular preventer's lid and plunger. The part is put in the lid's spherical hole and is made of a flexible material with rigid pieces that hold it together. The working surfaces will get worn out faster because of this design. When the tool is moved axially through it with a shuttered sealing element, the first thing to wear out is a narrow belt of flexible material located near the inner upper portion of the sealing element. Then, as it wears down, the belt gets wider until it reaches the maximum height of a

compressed sealing aspect at the end. So, the friction force as well as the dragging force go up, which can be a sign that the sealing element is getting worn [8,9].

The source considers a seal for a annular-type preventer. The sealer includes a large number of metal inserts embedded in the elastomeric body. The inserts are arranged radially at equal distances from each other around the longitudinal axis of the seal. They support the elastomeric body under radial compression, which ensures the sealing of the annular space. When the sealing assembly is compressed around the drill pipe, the elastomeric body is compressed radially in the direction of the longitudinal axis. Metal inserts move in the same direction. The disadvantage of this design is that in the closed position, the pressure in the borehole can affect the elastomeric body, which leads to a change in its stress state. As a result, significant stresses develop in certain areas of the elastomeric body, acting on the sealing unit in two directions: radially to the center and along the longitudinal axis upwards. At significant pressures of the reservoir fluid, stresses can lead to the destruction of the seal.

In the patent , the sealing element for the preventer as a reinforcing component contains flexible non - metallic composite bodies on a common annular base (Fig.1). Replacing metal inserts with a non-metallic composite elastic element improves the parameters of the stress-strain state of the seal and increases its service life [10].

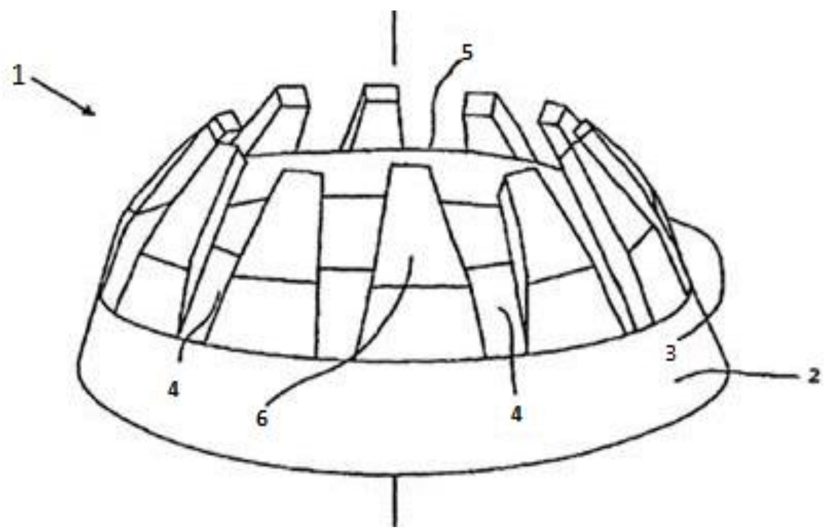


Figure 1: Sealing element: 1 - elastic reinforcing element; 2 - flexible non-metallic composite material; 3 - outer surface; 4 - spaces between inserts; 5 - inner surface; 6 - non-metallic composite inserts

Conclusion

The study of the existing designs of annular preventers and their seals allows us to conclude that the development of a sealing element for a wide range of diameters of sealed pipes is relevant, as well as the design of a sealer that allows sealing the mouth with an annular preventer in the absence of a tool in the well.

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HƏLQƏVİ PREVENTORUN KİPLƏNDİRMƏ DÜYÜNÜNÜN TƏDQİQİ

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XÜLASƏ

Məqalədə həlqəvi preventorun kipləndirici elementlərinin müxtəlif növləri araşdırılmışdır.sfetik və konik kipləndirici elementlərin konstriktiv formaları öyrənilmişdir. Xarici ölkə tədqiqatlarının təhlili ilə sferik formalı kipləndiricilərin modernləşdirilməsi tədqiq olunmuşdur. Atqıya qarşı avadanlıq yüksək dərəcədə etibarlı və istənilən vaxt işə hazır olmalıdır. Qazma kəməri quyuda olduğu və olmadığı halda quyu ağzının tam kipləndirməsi mümkün olmalıdır. Hal-hazırda istifadə edilən həlqəvi preventorların sferik kipləndirici elementləri universal deyillər və boru kəmərlərinin məhdudlaşdırılmış həddlərində işlədiklərindən quyuda qazma aləti olmadıqda quyu ağzını tam bağlaya bilmirlər. Həlqəvi preventor üçün kipləndiricini təhlil edək. kipləndirici özündə kipləndirici elementdə düzülmüş çoxlu sayda metallik taxmaları birləşdirir. Taxmalar kipləndiricinin uzununa oxu boyu bərabəq aralıqda düzülərək radial yerləşmişlər. Onlar həlqəvi fəzanın hermetikləşdirilməsini təmin edərək radial sıxılmada elastomer cisimi saxlayırlar. Kipləndirici düyün boru kəməri ətrafında sıxılarkən kipləndirici element uzununa ox istiqamətində radial sıxılır. Bu istiqamətdə həm də metallik taxmalar yerini dəyişir. bu konstruksiyanın çatışmayan cəhəti ondadır ki, quyu lüləsində bağlı vəziyyətdə təzyiq kipləndiriciyə təsir göstərə bilər, bu da onun gərginlikli vəziyyətinin dəyişməsinə gətirir. Nəticədə kipləndircinin müəyyən hissələrində kipləndirici düyünə iki istiqamətdə: mərkəzə doğru radial və uzununa ox boyu yuxarı əhəmiyyətli qiymətdə gərginliklər təsir edir. Lay mayesinin yüksək gərginliklərində bu kipləndiricinin dağılmasına gətirə bilər. Sferik həlqəvi preventorun qapağı ilə plunjer arasında yerləşdirilmiş həlqəvi kipləndirici element tədqiq edilmişdir. Kipləndirici element qapağın sferik yarığına yerləşdirilmişdir və sərt taxmalarla armirə edilmiş elastik materialdan ibarətdir. Bu konstruksiya işçi səthlərinin yeyilməsilə bağlı çatışmayan cəhətə malikdir. Alətin oxboyu yerdəyiməsi zamanı bağlı kipləndirici elementdən əvvəlcə elastik materialın yuxarı hissəsindən nazik bir zolağı yeyilməyə başlayır və sonra yeyilmə getdikcə, zolağın eni böyüyərək, sonda kipləndiricinin tam hündürlüyünü əhatə edir.
Açar sözlər: həlqəvi preventor, armirə olunmuş metallik taxmalar, sferik kipləndirici element, konik kipləndirici element, elastiki cisim.

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ИССЛЕДОВАНИЕ УПЛОТНИТЕЛЬНОГО УЗЛА КОЛЬЦЕВОГО ПРЕВЕНТОРА

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РЕЗЮМЕ

В статье изучены разные типы герметизирующих манжет для превентора кольцевого вида. Изучалось конструктивные виды герметизирующих манжет разного геометрического вида. Исследовалось моделирования сферических манжет при исследовании работ разных предприятий.

Работающие в настоящее время герметизирующие манжеты для кольцевых превенторов не способствуют и работают в разных эксплуатационных труб, также не позволяют полностью открыт колонны когда в скважине не имеется разных оборудований. Предусмотрена герметик для оборудование в виде геометрических форм. Герметический манжет включает в себя умеренное количество не металлических болтов, встроенных в резиновый элемент. Вставки расположены продольно на неравных расстояниях вблизи элементов вокруг поперечной оси герметизирующего манжеты. Эти придерживают резиновых манжет при продольном сжатии, и обеспечивает уплотнения скважинного пространства. При снятии герметизирующих манжеты оси эксплуатационной колонны герметизирующий элемент сжимается поперечно в напротив колонной длины. Недостаток этого устройства заключается в том, что в открытом направлении давление в пространстве скважины может не влиять на уплотняющий манжет, это приводит к направлении его сжатого состояния. В результате на определенных участках резиновых манжет развиваются разные виды напряжения, влияющие на герметизирующий манжет в одном направлении: круговое к центру и вдоль поперечной оси вниз. В незначительных падении скважинной жидкости давление смогут привести к разрыву герметика. Исследована круговой герметизирующий элемент, размещенный между кожухом и пистоном круглого оборудования для закрытии устья. Герметик установлен в радиальной полости кожуха и состоит из резинового материала, укрепленного жесткими болтами. У этого оборудование имеет есть недостатки, которые при его работы изнашивается рабочие поверхности. При продольном перемещении узла через открытый уплотнительный герметический элемент сперва изнашивается широкий пояс резинового материала наверху наружной верхней кромки герметизирующего элемента. После, при его работы, длина пояска уменьшается, доходя от начале до конца герметика.

Ключевые слова: герметизирующий манжет, повышение пластовой давлении, сферический герметизирующий манжет, противовыбросовое оборудование, бурильные трубы.

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STUDY OF SELF-DRYING EFFECT OF PACKER INSTALLATIONS IN EXPLOITATION WELLS

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ABSTRACT

The article considers the effect of self-compacting of packer structures in production wells. In order to reduce the high costs of oil and gas companies, the issues of self-compacting packers in producing production wells are being studied. The design used here is centered in the open hole, and the rubber elements of the packers prevent leakage in the event of a pressure drop.

In general, the sealing assembly consists of a sealing surface, sealing elements, an auxiliary protective structure and a power mechanism. Under downhole conditions, the operating pipeline is not part of the seal assembly and varies from well to well. For this reason, the principle of operation of the packer's sealing unit cannot be justified from the point of view of the roughness of the sealing surface and the specified limits on the nature of the gas-liquid medium to be separated. This indicates that the operating conditions of the well packer are significantly different from the operating conditions of other sealing structures.

Despite the effectiveness of the use of packers, the low manufacturability of the sealing elements does not allow them to be widely used. Most often, this manifests itself in special difficult conditions, at the same time, in operating conditions, when the sealing material is broken, the rubber material flows onto the metal part of the packer, the rubber sticks to the wall of the production string, in some cases, tubing is captured. The performance of packer equipment is determined by the performance of its sealing elements. Since the sealing elements are mainly rubber-like construction materials, their design is unreliable in mountain conditions.

The packer is released into the well by tubing. When the required depth is reached, water is pumped into the packer barrel (through the NCU). In this case, the valve is connected to the fluid pressure in the packer hydraulic cylinder, and the piston moves, compresses the rubber cuffs through the support washer and delivers them to the inner surface of the working belt. He pushes the cone under the plates and thus shrinks the packer.

To drive the lower layer into the packer, the pressure is increased by an additional 3.5 MPa (23 ... 25 MPa from the landing pressure) and the mortise screws are cut off, the ball and seat are released from the packer. The packer channel opens. At this time, under the pressure of the well product (oil or gas), the round plates in the anchor are pressed against the belt, which prevents the packer from slipping upwards. To release the packer from the well, just pull it up. The packer consists of the mechanisms of the upper and lower devices, the clamping collar assembly, the saddle valve, the hydraulic cylinder, the circulation valve.

Relevance. The study of the shaping units of packer structures and the choice of criteria that provide the shaping effect is a topical issue.

Keywords: conditioning elements, wellbore, packer assembly, horizontal well, open hole staged fracturing.

The packer is lowered into the well by a series of pump-compressor pipes. The packing of the packer is done with two rows of pipes. These pipes are connected to the packer through a stock. When the liquid of the second line of the pipeline is pumped, the piston mechanism under the plates is activated, the plates move and create a jam on the wall of the belt.
The pressure on the piston also compresses the rubber cuffs and creates a crack in the wall of the belt, thus breaking the connection between the upper layer and the lower layer, hermetically separating from each other. The compressed state of the tires is maintained by the slip mechanism. The teeth of these slips and the teeth on the piston are connected in such a way that the movement is released in the direction of rubber compression, and the movement is released in the reverse direction. After the packing of the packer is completed, the pressure is increased, the cutting screws in the valve node are cut, the ball and the saddle are thrown into the well, and the passage of the packer is opened.
During the removal of the packer from the well, it is necessary to reduce the pressure to zero and lift the second row of its pump-compressor pipes.

Introduction

The main disadvantage of rubber-metal molding elements is the severe working conditions at the metal head boundary, concentration of stresses, separation of layers in the vulcanized part, as a result of which the integrity of the rubber is broken. The use of harder rubber on the ends of the outer elements has given good results in improving the performance of the rubber-based molding elements in the packers. The works carried out in the field of determining the rational height and diameter depending on the worker deformation, and studying the diameter of the well and packer barrel are of interest. Nevertheless, the problems of deformation in the zone of stress concentration have not been studied for packers used in well repair, as the deformation of the packers occurs due to the tight compression of the outer rubber coating on the installed operational belt and the effect of internal excess pressure, and the lack of the deformation elements is as described above. In addition, when there is sand in the removed liquid, it settles into the groove of the inner wall with the barrel of the packer, as a result, the groove cannot return to its previous position when the packer is removed, and it becomes difficult to remove it.
During full compression, the rubber must withstand practically all pressure drops. However, the existence of a gap between the body of the packer used in the wells in need of repair and the inner surface of the production belt for lifting and lowering operations fills this gap by pressing the molding material and compressing the shaft and increasing the contact stresses. The compacted material can be disintegrated, as the rupture strength of the rubber is not very great, and it cannot remain in this zone during pipe removal due to residual deformation. Thus, in order to obtain a reliable hermetic seal during the operation of this type of molding elements, it is necessary to prevent the rubber from flowing into the void.
In some designs, a protective body is used to prevent the cuffs from being deflated during unloading in the packers, to which an elastic cover of the self-contained cuffs is installed in advance. During the installation of the barrel in the well at the specified interval, the casing is removed under the pressure of the liquid. The disadvantage of protective structures is their difficult preparation, the difficulty of removing the body, one-time operation. Also, after lowering the packer into the well, the hermeticity is weakened due to the wear of the cuffs. In this case, the working conditions of self-locking cuffs are slightly improved. The advantage of using self-

locking cuffs is that they can be packed without the use of an anchor device in any part of the barrel, it is not difficult to prepare the structure, and it can withstand drops of insufficient pressure during operation.

The oil and gas fields of Azerbaijan are in the late or final stage of development, which is characterized by the progressive flooding of producing wells. The development of oil fields using the water impact method also contributes to an increase in the water cut of the produced products. In such conditions, the problem of limiting water inflows is of particular relevance. Modern technologies for preventing the liquidation of water entering the well are very diverse and include a large number of both chemical and technical methods of reservoir isolation. In particular, water-swellable polymers, gel-forming and sludge-forming polymer systems, silicon-containing compositions, as well as emulsion compositions, resins, latexes, and many others are used when carrying out isolation work by pumping selective and non-selective materials. However, the results of pilot tests have shown that the use of these insulating compounds does not always bring a sufficient effect.

One of the simplest and most reliable ways to isolate flooded flows is to use packers of various designs. Packer (packer - English seal) - a device designed to separate individual zones of the wellbore and isolate the internal space of the production casing from the impact of the well environment. The packer is lowered into the well as part of the casing string and is set in the specified interval. According to the installation method, packers are divided into mechanical, hydraulic and hydromechanical. A mechanical packer expands under the influence of an axial load - the mass of tubing. The sealing element of a hydraulic packer expands when fluid is applied to it. It should be noted that hydraulic

packers are able to withstand large pressure drops but are complex in design. Mechanical packers have a simpler design compared to hydraulic packers, but in some cases the weight of the pipe string is not always enough to seal the element.

Packers (hydraulic, mechanical, etc.) are recommended to be installed in open wells in places where stable, impermeable rocks occur; they can be installed in wells with soft, loose and unstable rocks, since the rubber sealing element is able to protect the well walls from disrupting the formation integrity.

Study of self-drying effect of packer type electric submersible pump is designed to work in difficult conditions (sand formation, salt deposition and corrosion aggressiveness). Packer produces oil from deep wells and works in complex conditions consisting of aggressive and mechanical mixtures (sand, clay, salt).

The well filter complex is designed to be used in operational wells with strong sand exposure at the bottom of the well in front of the operating horizon. The complex includes a lower separator, well filters, spare separators connecting them, a mechanical packer that is hermetically seated in the operational belt with reference to the bottom of the well, and a belt separator that has the function of separating the lift pipes used to lower the complex from the installed equipment.

The paker-type belt separator is designed to carry out the lifting of the lift pipes by ensuring the safe separation of the lowered lift pipes from the installed packer hydraulically or mechanically after the MDP-type mechanical support packer is installed in the operational belt of the well filter complex, which is installed in the bottom of the well against strong sand occurrence in operational wells.(Figure 1.)

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Mechanical packer

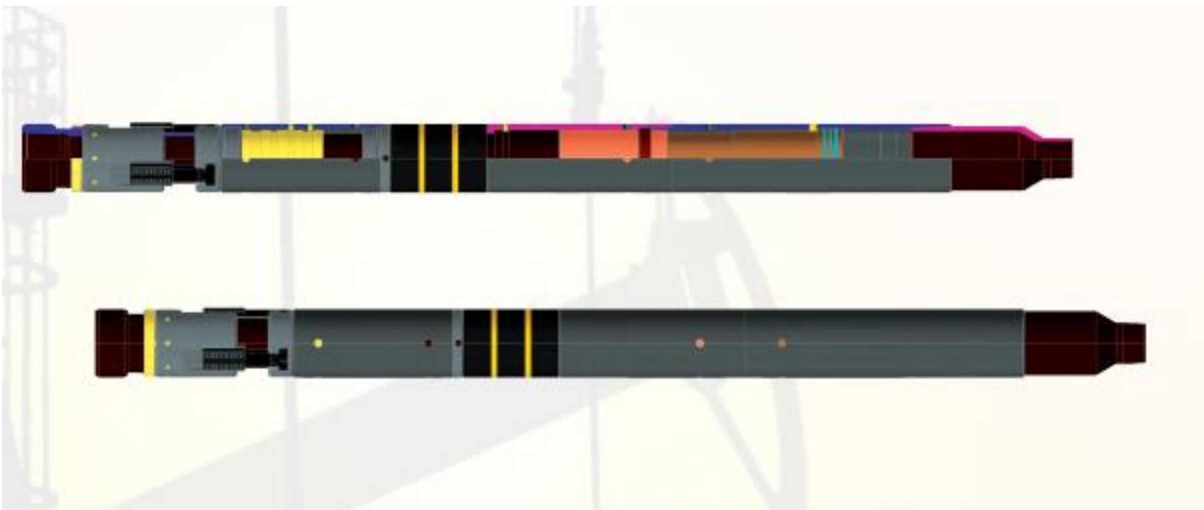


Figure 1: Belt splitter

The large-pass mechanical support packer enters the well filter complex installed at the bottom of the well against strong sand manifestation in the wells in operation, while keeping that equipment hermetically and immovably in the filter zone, the flow of sandy 0fluid coming to the bottom of the well only passes through the lowered well filter to the working bodies of the equipment working with the mechanical and compressor method. has the function of ensuring access

The layered-type mechanical packer is designed for the hermetic isolation of the production line from the layer or multi-layered operation or in percussive wells. The packer is installed in the production line at a distance of 300 m from the wellhead by manipulating the lift pipes up and down and lifting the pipes. can be used to check the tightness of the service belt and to locate the damaged zone (Figure 2.).

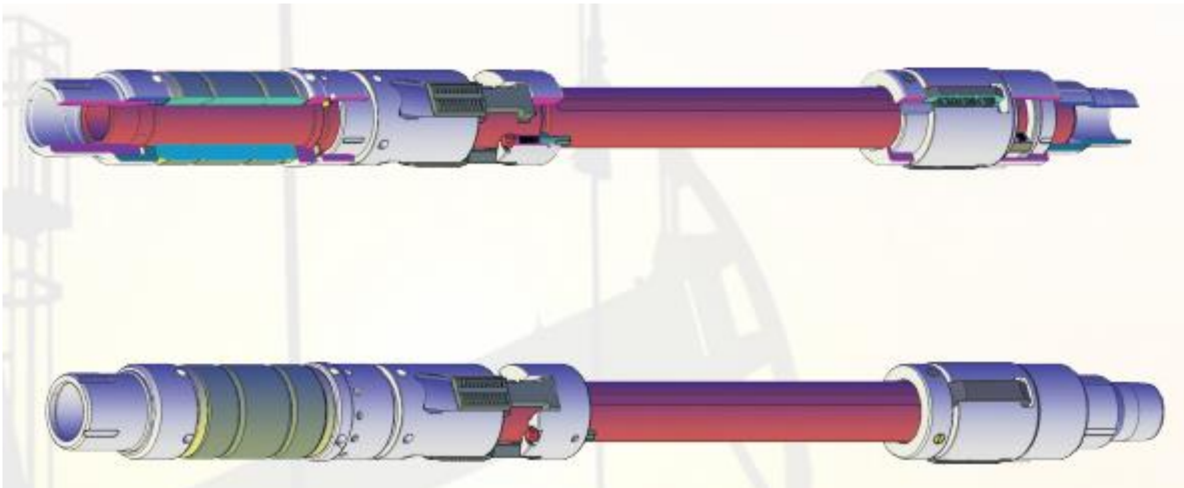


Figure 2: The layered-type mechanical packer

Conclusion

The above indicates that the correct choice of the packer for the appropriate type of well leads to savings in labor time and costs throughout the entire life of the well, and also prevents expensive repairs in the future. Taking into account that the oil fields of Azerbaijan are at a late stage of development, the water cut of production wells is high, the casing strings of a large number of wells are damaged, it is considered expedient to increase the efficiency of packer seals in wells.

We provided information on the variety and categories that Packer can offer, including description and recommendations of new technologies of packer-type self-service systems. Finally, finishing works and pipe stress analysis were performed.

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İSTİSMAR QUYULARINDA PAKER QURULUŞLARININ ÖZ-ÖZÜNƏ KİPLƏNDİRMƏ EFFEKTİNİN TƏDQİQİ

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XÜLASƏ

Məqalədə istismar quyularında paker quruluşlarının öz-özünə kipləndirmə effektinə baxılmişdir. Neft-qaz şirkətlərinin yüksək xərclərinin azadılması üçün istismar quyularında pakerlərin öz-özünə kipləndirmə məsələləri öyrənilir. Burada istifadə olunan konstruksiya açıq quyuda

mərkəzləşdirilir və təzyiq düşməsinin baş verməsi halında pakerlərin rezin elementləri sızmanın qarşısının alınmasını təmin edir.
Ümumi halda pakerlərin kipləndirici düyünü kipləndirilən səthdən, kipləndirici elementlərdən, köməkçi qoruyucu quruluş və güc mexanizmindən ibarətdir. Quyu şəraitində istismar kəməri kipləndirici qurğunun tərkibinə daxil deyil və quyudan quyuya dəyişir. Bu səbəbdən pakerin kipləndirici düyününün iş prinsipi kipləndirilən səthin araboşluğunda və ayrılan qaz-maye mühitin xarakterinə uyğun dəqiq verilmiş hədlərdə əsaslandırıla bilinmir. Bu quyu pakerinin iş şəraitinin digər kipləndirici quruluşlara nisbətən əhəmiyyətli dərəcədə fərqli olduğunu göstərir.
Paker quyuya nasos-kompressor boruları ilə buraxılır. Lazımi dərinliyə çatdırıldıqda pakerin lüləsinə (NKB-vasitəsilə) su vurulur. Klapan bu halda bağlı olduğu pakerin hidrosilindrində mayenin təzyiqi qalxır və porşen hərəkətə gələrək rezin manjetləri dayaq şaybası vasitəsilə sıxır və onları istismar kəmərinin daxili səthinə çatdıraraq kipləşdirir. Konusu plaşkaların altına itələyir və beləliklə paker oturdulur.
Aşağı layı pakerin içərisinə yönəltmək üçün təzyiq 3,5MPa əlavə (oturdulma təzyiqindən 23…25MPa) artırılır və kəsici vintlər kəsilir, kürə yəhərlə birlikdə pakerdən azad olur. Pakerin kanalı açılır. Bu zaman quyu məhsulunun (neft və ya qaz) təzyiqində lövbərdəki dairəvi plaşkalar kəmərə sıxılır, bu da pakerin yuxarıya sürüşməsinin qarşısını alır. Pakeri quyudan azad etmək üçün onu yuxarı dartmaq kifayətdir. Paker yuxarı və aşağı plaşka mexanizmlərindən, kipləndirici manjet düyünündən, oturtma klapanından, hidrosilindrdən, sirkulyasiya klapanından ibarətdir.
Aktuallıq. Paker quruluşlarının kipləndirmə düyünlərinin tədqiqi və kipləndirmə effektini təmin edən meyarların seçilməsi aktual məsələdir.
Açar sözlər: kipləndirici elementlər, quyunun lüləsi, pakerləyici qurğusu, üfüqi quyu, özükiplənən manjet

ИССЛЕДОВАНИЕ ЭФФЕКТА САМОУПЛОТНЕНИЯ ПАКЕРНЫХ УСТРОЙСТВ В ЭКСПЛУАТАЦИОННЫХ СКВАЖИНАХ

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РЕЗЮМЕ

В статье рассмотрен эффект самоуплотнения пакерных конструкций в эксплуатационных скважинах. С целью уменьшения высоких затрат нефтегазовых компаний изучаются вопросы самоуплотнения пакеров в добывающих эксплуатационных скважинах. Используемая здесь конструкция центрируется в открытом стволе скважины, а резиновые элементы пакеров предотвращают утечку в случае падения давления.
В целом уплотняющий узел состоит из уплотнительной поверхности, элементов уплотнения, вспомогательной защитной конструкции и силового механизма. В скважинных

условиях работающий трубопровод не входит в состав блока уплотнения и варьируется от скважины к скважине. По этой причине принцип работы уплотнительного узла пакера не может быть обоснован с точки зрения шероховатости уплотнительной поверхности и заданных пределов по характеру разделяемой газожидкостной среды. Это свидетельствует о том, что условия работы пакера скважины существенно отличаются от условий работы других уплотняющих конструкций.

Несмотря на эффективность применения пакеров, низкая технологичность элементов уплотнения не позволяет их широко использовать. Чаще всего это проявляется в особых сложных условиях, в то же время в условиях эксплуатации, когда уплотнительный материал нарушен, резиновый материал натекает на металлическую часть пакера, резина прилипает к стенке эксплуатационной колонны, в ряде случаев, происходит захват насосно-компрессорных труб. Производительность пакерного оборудования определяется работоспособностью его уплотнительных элементов. Поскольку уплотнительные элементы в основном представляют собой резиноподобные конструкционные материалы, их конструкция ненадежна в горных условиях.

Пакер выпускается в скважину насосно-компрессорными трубами. При достижении необходимой глубины в ствол пакера (через НКБ) закачивается вода. При этом клапан подключается к давлению жидкости в гидроцилиндре пакера, а поршень движется, сжимает резиновые манжеты через опорную шайбу и доставляет их на внутреннюю поверхность рабочего пояса. Он проталкивает конус под пластины и таким образом усаживает пакер.

Для забивки нижнего слоя в пакер давление повышают дополнительно на 3,5 МПа (23...25 МПа от посадочного давления) и срезают врезные винты, шар и седло освобождают от пакера. Канал пакера открывается. В это время под давлением скважинного продукта (нефти или газа) круглые пластины в якоре прижимаются к ремню, что препятствует соскальзыванию пакера вверх. Чтобы высвободить пакер из скважины, достаточно потянуть его вверх. Пакер состоит из механизмов верхней и нижней устройств, узла прижимной манжеты, седельного клапана, гидроцилиндра, циркуляционного клапана.

Актуальность. Изучение формообразующих узлов пакерных конструкций и выбор критериев, обеспечивающих формообразующее воздействие, является актуальным вопросом.

Ключевые слова: уплотнительные элементы, ствол скважины, пакерное устройства, горизонтальная скважина, самоуплотняюший манжет.

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IMPLEMENTATION AND RESEARCH OF INTELLIGENT INFORMATION RETRIEVAL AND DATA ANALYSIS IN WEB APPLICATIONS

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ABSTRACT

The main stages of Web-Mining were described, the main difference between information extraction and information retrieval was highlighted in the article. The contents of Web Content Mining (extraction of Web content), Web Structure Mining (extraction of Web structures), and Web Usage Mining (analysis of the use of Web resources) have been clarified separately.
In the section entitled "Information systems for Data Mining and processes in Web Applications", it was shown that when using Web Mining, developers face several types of challenges.
Also, the main approaches to conducting intelligent search of information and data analysis in web applications were discussed in the article. The components of the Data Mining model and the stages of its application was considered. As a practical example of the implementation of a software product for research, Russian development - the program PolyAnalyst was considered.
It was also noted that the professional version of the system - PolyAnalyst Pro allows us to analyze various data formats and optimize business processes. The system performs a full range of data analysis tasks: loading, combining, cleaning and transforming data, deep text analysis, extracting information, visualizing results and creating reports.
In the conclusion part it was noted that to improve the efficiency of work in real time, the creation of new software tools using Web Mining can bring maximum benefits. Building such intelligent analyzers can help analyze log files efficiently.
Keywords: Web Mining, Data Mining, Web applications, information retrieval, Web resources.

As information technology spreads, the volume of information stored in databases increases, which leads to the development of data mining methods - a discipline that studies the process of finding new, valid and potentially useful knowledge in databases. Mining analysis lies at the intersection of several sciences, the main ones being database systems, statistics and artificial intelligence.
Intelligent methods mean such methods of solving problems, which are based on algorithms and actions, to a greater or lesser extent related to the intellectual activity of a person, his evolution, everyday behavior.
At present, all users of web services use a large amount of information taken from the Internet, hence the need for automatic information analysis. With the development of the World Wide Web into a global information infrastructure, ordinary users are now both consumers of information and its creators and distributors. Therefore, for the effective structuring of the tasks of searching, solving and analyzing randomly organized information in the network, a new direction in the methodology of data analysis is intended – Web Mining.

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Web Mining emerged from disciplines such as knowledge discovery in databases, efficient information retrieval, artificial intelligence, machine learning, and natural language processing [3,p.418].

Due to the variety and abundance of information, Internet users often face problems in analyzing and finding the necessary information. There are some problems of working with information on the World Wide Web:

- Search for meaningful information. Not all links presented to the user carry the necessary information and it is extremely difficult to search for non-indexed information.
- Discovery of new knowledge. Among all the information received, it is difficult to extract useful knowledge.
- Personalization of information. There is a difficulty with understanding the knowledge gained, the concept of ideas invested by the author.
- Study of the consumer or individual user. The user does not always get exactly the information he wants to receive.

Various technologies are used to solve these problems. These include: databases, information retrieval, natural language processors, etc. Web Mining technology is aimed at both direct and indirect solutions to these problems.

WebMining is a technology that uses Data Mining methods to explore and extract information from Web documents and services [9,p.124].

Web-Mining Applications

Data Mining is a technology for extracting and searching data for hidden and useful patterns for business. This technology includes three main stages: research, model building and its verification.

Patterns are searched using various kinds of mining software. Data mining involves solving one or more problems: classification, recognition, prediction, estimation, association, or clustering. For example, the classification problem is one of the most common. Due to the fact that information on the Internet is heterogeneous, the classes of objects of classification are far from clear boundaries and can be described in terms of fuzzy logic. When solving the issues of forming classifiers, the problems of optimal formation of bases of fuzzy rules for classification arise [7,p.38].

There are the following stages of Web Mining:

- search for resources - obtaining data from sources;
- extracting information - extracting information from found Web resources;
- generalization - detection of common patterns in separate and intersecting sets of sites;
- analysis and interpretation of results [10, p.147].

Searching for resources means searching various Web sources for keywords. This stage is divided into: search for documents and search for services.

Most of the work of searching for resources comes down to the automatic creation of search indexes of Web documents. The most popular robots are WebCrawler and AltaVista.

For example, in one experiment, a volunteer used the keywords “Conference” and “Australia” and performed searches using the search engines AltaVista, Excite, Yahoo, Lycos. These search engines shown below returned a large number of results.

Search query: Conference, Australia.

Search engines use: AltaVista, Excite, Yahoo, Lycos.
We checked the first 600 pages returned by each search engine because we believe it is unlikely that a user will search more than 600 pages in a single query. This may be due to the time constraints that many users have when searching for certain information.
Indeed, it is very unlikely that a user would, for example, search for 26194461 results returned from Alta Vista for the above query.

Table 1: Searches Using The Search Engines – AltaVista, Excite, Yahoo, Lycos

Search Engines	Number of pages returned	Number of relevant pages
AltaVista	Conference: 26194461 & Australia: 34334654	2050
Excite	2,811,220	1889
Yahoo	40 categories and 257 sites	84 sites were relevant
Lycos	673,912	2210

We checked the first 600 pages returned by each search engine because we believe it is unlikely that a user will search more than 600 pages in a single query. This may be due to the time constraints that many users have when searching for certain information.
Indeed, it is very unlikely that a user would, for example, search for 26194461 results returned from Alta Vista for the above query.
Further, after the discovery of resources, information must be extracted from them, subjected to analysis and generalization. At the stage of generalization, Data Mining methods are applied to the extracted information. At this stage, a person plays an important role. At the last stage, he will have to interpret the results.
In addition to Web Mining, there are Internet technologies such as Information Retrieval (IR) and Information Extraction (IE).
Information Retrieval (IR) technology consists in obtaining documents from the Internet that are relevant and important to users' requests. But often the received documents include both useful and, vice versa, not useful information. This technology uses Data Mining methods to classify documents. We must note that Web Mining is part of the IR technology.
The main difference between Information Extraction technology and Information Retrieval is that it works with a document and searches for the necessary information in it, while IR works with many documents, extracting the necessary document. Various methods and technologies can be used together.
The following categories of Web Mining are distinguished in the literature [9,p.126]:

- Web Content Mining (extraction of Web content),
- Web Structure Mining (extraction of Web structures),
- Web Usage Mining (analysis of the use of Web resources).

Examples of using Web Mining are Netflix and the world-famous Google search engine.
Web Mining is a very promising area of analysis of Internet resources for optimizing the structure of websites, obtaining knowledge about site visitors, automatic search and structuring of information from the Internet.
When using OLAP systems, the analyst is provided with means for testing hypotheses when analyzing data. The main task of the analyst is the generation of hypotheses. He decides it based

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on his knowledge and experience. However, not only a person has knowledge, but also in the accumulated data that are analyzed. Such knowledge is often called "hidden" because it is contained in gigabytes and terabytes of information that a person is not able to explore on their own. In this regard, there is a high probability of missing hypotheses that can bring significant benefits.

Information systems for Data Mining and processes in Web Applications

In modern conditions of development of information technologies (IT), global networks are widely used for information exchange. At the same time, Internet users use a significant amount of various information, which should be automatically analyzed.

In order to carry out a structured search, as well as the analysis of unstructured information, a whole direction in the development of data analysis appeared on the network, which was called intelligent information retrieval or Web Mining.

Web Mining is a state-of-the-art technology for discovering usable information in large datasets on a network based on Data Mining. Data Mining uses mathematical analysis to uncover patterns and trends that exist in data. As a rule, it is very difficult to detect such patterns during normal data viewing due to the huge amount of data [1,p.117].

All patterns and trends are combined into a Data Mining model. Such models can be applied to solve specific problems:

- forecasting;
- risk and probability assessments;
- development of recommendations;
- searching for sequences;
- grouping [2,p.23].

The term Web Mining was used mainly in three directions. The first, called Web Content Mining, describes the process of discovering information or a resource from millions of WWW sources. The second, called Web Structure Mining, is the process of extracting structural information from the Web. The third, called Web Usage Mining, is the process of analyzing Web access logs or other user information and access on one or more nearby networks. Web Mining can be broadly defined as finding and analyzing useful information from the WWW. This broad definition, on the one hand, describes automatic searching, the retrieval of information and tools available from millions of sites and interconnected databases, on the other hand, the discovery and analysis of user access patterns from one or more Web servers.

There are several stages of using Web Mining technology:

1. Search for resources (input stage)- search for unstructured data from various sources;
2. Extraction of information (preprocessing satge) - the data is converted into the form necessary to build the model;
3. Generalization (pattern discovery stage) - the stage of modeling;
4. Analysis (pattern analysis stage) is the stage of model analysis and results interpretation. [5,p.218].

These stages are generalized for searching and analyzing the necessary information on the Internet. The specific steps depend on the specific task at hand. Among the various categories of Web Mining, Web Usage Mining is an analysis of the use of web resources, which provides the following information: pages viewed by the user, as well as the sequence of viewing these pages.

This use of data provides access to the paths of visited pages. Such information is often automatically collected into visit logs by a web server. CGI (Computer-Generated Imagery) scripts offer other useful information such as link logs, user subscription information, and overview logs. The results of Web Usage Mining can be web server data, service applications, or application layer data.

Web Structure Mining considers the relationships between web pages based on their relationships. This model is used to classify a web page and determine the similarities between different resources.

When using Web Mining, developers face several types of challenges. The first task concerns the collection of data, and the second - the use of personalization methods. After collecting a certain amount of data about the client, the system will accumulate any knowledge, in accordance with the information received, and then can recommend it to him. As a result of collecting a certain volume of personalized retrospective data about a particular user, the system accumulates certain knowledge about him and can recommend any goods or services to him. Based on information about all users visiting the site, the system can determine groups of visitors in order to recommend products or send certain information [3, p.423].

In general, Web Mining technology is designed to search for the necessary information and identify knowledge from web resources, despite the imperfections of search engines, as well as to analyze the structures of network segments. An example of using Web Mining in practice is the well-known search engine Google.

At the same time, it is necessary to recognize the fact that at the moment the process of processing unstructured data is imperfect and many development companies are faced with this problem. However, IT is constantly evolving and more and more accurate software solutions are entering the market, which in the near future will solve this problem, including in the field of intelligent information retrieval and data analysis in web applications.

The Russian development of “Megaputer”company, PolyAnalyst system, is a leader among systems for extracting useful information from both structured and unstructured data. No matter what data sources are used, what the analysis tasks are and what data analysis skills the performer has, PolyAnalyst allows us to extract valuable and interpretable information necessary for making various management and business decisions. The PolyAnalyst system combines the following elements:

- the latest natural language processing (NLP) algorithms;
- a wide range of statistical tools and machine learning algorithms;
- built-in tools for creating graphical reports. [8,p.40].

PolyAnalyst provides the ability to implement all stages of data analysis:

- loading data from files, databases, documents, e-mail, social networks;
- data cleansing and transformation;
- natural language processing, entity and relationship extraction;
- trending and predictive modeling;
- presentation of results in the form of customized reports;
- the ability to export and import analytical solutions.

The professional version of the system - PolyAnalyst Pro allows us to analyze various data formats and optimize business processes. The system performs a full range of data analysis tasks:

loading, combining, cleaning and transforming data, deep text analysis, extracting information, visualizing results and creating reports.

Importantly, Poly Analyst Pro offers a large selection of machine learning tools that allow us to solve clustering and classification problems, predict numerical values, detect anomalies, group values based on similarity, perform social network analysis and time series modeling.

Head Lecturer of the Institute of Computational Mathematics and Information Technologies of the Kazan Federal University A.M. Gusenkov developed an approach for the intelligent search of complex objects in various types of structurally marked texts, which can be applied to the processing of “Big Data”, which is typical of web applications [8,p.42]. At the same time, the source of information for constructing an ontology and, in the future, organizing intellectual search are texts in natural language, which refer to semi-structured data.

Thus, the analysis shows that Web Mining technology is designed to search for the necessary information and identify knowledge from web resources, despite the imperfections of search engines, as well as to analyze the structures of network segments. Today, in the scientific community, methodological developments are being made to improve the procedures and stages of Web Mining. Practical developments in intelligent information retrieval and data analysis in web applications are reflected in the creation of the domestic PolyAnalyst system.

Methods for extracting knowledge about the use of the Internet, at the moment, are becoming increasingly popular. It can be said that at the moment there are practically no well-functioning systems that allow accurate analysis of the Web, and existing systems are not very effective. At the same time, due to the sharp increase in the number of Web users, the market demand for such information systems is extremely high. To this end, to solve important problems in this area, the application of Data Mining methods can help solve a number of problems such as user identification, access session identification, confidentiality preservation, transaction identification, etc.

Web-based Data Mining technologies open the way not only for data collection, but also raises many issues related to data security.

To improve the efficiency of work in real time, the creation of new software tools using Web Mining can bring maximum benefits. Building such intelligent analyzers can help analyze log files efficiently.

When developing a business process support system, the analyst needs to build a detailed model that accurately describes the real business process. Modeling a business process without using a data mining system is a complex task that requires comprehensive knowledge of the process (communication with employees and managers participating in the business process), which takes a lot of time, and often the results are very subjective. That is why in modern scientific literature there is a growing interest in solving this problem to a greater extent by means of Mining analysis.

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VEB TƏTBİQLƏRİNDƏ VERİLƏNLƏRİN İNTELLEKTUAL AXTARIŞININ VƏ VERİLƏNLƏRİN ANALİZİNİN TƏTBİQİ VƏ TƏDQİQİ

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XÜLASƏ

Məqalədə Web-Mining-in əsas mərhələləri təsvir edilmiş, informasiyanın çıxarılması ilə informasiya axtarışı arasındakı əsas fərq vurğulanmışdır. Web Content Mining (Veb məzmunun çıxarılması), Web Structure Mining (Veb strukturlarının çıxarılması) və Web Usage Mining (Veb resurslarının istifadəsinin təhlili) məzmununa ayrıca nəzər salınmışdır. “Veb Tətbiqlərdə verilənlərin əldə edilməsi üçün informasiya sistemləri və proseslər” adlı bölmədə Web Mining-dən istifadə edərkən tərtibatçıların bir neçə növ problemlə üzləşdiyi göstərilmişdir.

Məqalədə həmçinin veb proqramlarda verilənlərin intellektual axtarışı və verilənlərin analizi üçün əsas yanaşmalar müzakirə edilmişdir. Data Mining modelinin komponentləri və onun tətbiqi mərhələləri nəzərdən keçirilmişdir. Tədqiqat üçün proqram məhsulunun tətbiqinin praktiki nümunəsi olaraq Rusiyada işlənib hazırlanmış PolyAnalyst proqramı nəzərdən keçirilmişdir.

Həmçinin qeyd olunmuşdur ki, sistemin peşəkar versiyası - PolyAnalyst Pro müxtəlif verilən formatlarını təhlil etməyə və biznes proseslərini optimallaşdırmağa imkan verir. Sistem verilənlərin analizi tapşırıqlarının tam spektrini yerinə yetirir: verilənlərin yüklənməsi, birləşdirilməsi, təmizlənməsi və dəyişdirilməsi, dərin mətn analizi, verilənlərin çıxarılması, nəticələrin vizuallaşdırılması və hesabatların yaradılması.

Qeyd edilib ki, WebMining veb-sənəd və xidmətlərdən məlumatların tədqiqi və çıxarılması üçün verilənlərin öyrənilməsi üsullarından istifadə edən texnologiyadır.
WebMining - verilənlər bazalarında bilik kəşfi, səmərəli məlumat axtarışı, süni intellekt, maşın təlimi və təbii dilin emalı kimi intizamlardan ortaya çıxmışdır.
Yekun hissəsində qeyd edilmişdir ki, real vaxt rejimində işin səmərəliliyini artırmaq üçün Web Mining-dən istifadə etməklə yeni proqram vasitələrinin yaradılması maksimum fayda verə bilər. Belə ağıllı analizatorların yaradılması loq fayllarını səmərəli şəkildə analiz etməyə qatqı göstərə bilər.
Açar sözlər: verilənlərin intellektual analizi, verilənlərin hasil edilməsi, Veb proqramları, verilənlərin axtarışı, Veb resurslar.

ВНЕДРЕНИЕ И ИССЛЕДОВАНИЕ ИНТЕЛЛЕКТУАЛЬНОГО ПОИСКА ИНФОРМАЦИИ И АНАЛИЗА ДАННЫХ В ВЕБ-ПРИЛОЖЕНИЯХ

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РЕЗЮМЕ

В статье были описаны основные этапы Web-Mining, выделено главное отличие добычи информации от информационного поиска. Содержимое Web Content Mining (извлечение веб-контента), Web Structure Mining (извлечение веб-структур) и Web Usage Mining (анализ использования веб-ресурсов) разъяснено отдельно.
В разделе «Информационные системы для интеллектуального анализа данных и процессы в веб-приложениях» было показано, что при использовании веб-майнинга разработчики сталкиваются с несколькими типами проблем.
Также в статье были рассмотрены основные подходы к проведению интеллектуального поиска информации и анализа данных в веб-приложениях. Рассмотрены компоненты модели Data Mining и этапы ее применения. В качестве практического примера реализации программного продукта для исследований была рассмотрена российская разработка - программа PolyAnalyst.
Также было отмечено, что профессиональная версия системы - PolyAnalyst Pro позволяет анализировать различные форматы данных и оптимизировать бизнес-процессы. Система выполняет полный спектр задач по анализу данных: загрузка, объединение, очистка и преобразование данных, глубокий текстовый анализ, извлечение информации, визуализация результатов и создание отчетов.
Было отмечено, что WebMining — это технология, использующая методы интеллектуального анализа данных для изучения и извлечения информации из веб-документов и сервисов.

Веб-майнинг возник из таких дисциплин, как обнаружение знаний в базах данных, эффективный поиск информации, искусственный интеллект, машинное обучение и обработка естественного языка.
В заключительной части было отмечено, что для повышения эффективности работы в режиме реального времени создание новых программных инструментов с использованием Web Mining может принести максимальную пользу. Создание таких интеллектуальных анализаторов может помочь эффективно анализировать файлы журналов.

Ключевые слова: веб-майнинг, интеллектуальный анализ данных, веб-приложения, поиск информации, веб-ресурсы.

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INCREASING THE FLUSHING SAFETY OF THE DRILLING PROCESS AND THE PERFORMANCE OF SEALING ELEMENTS OF BLOW OUT PROTECTION EQUIPMENT

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ABSTRACT

The article is devoted to the study of the choice of the most effective control of technological processes for the prevention and elimination of gas, oil and water intrusions based on establishing the reliability, performance and durability of blowout control equipment. In this regard, the technical condition of the sealing elements of rams preventers, which generally meet all the requirements for the normal performance of blowout safety tasks, is of paramount importance.In order to evaluate and predict the performance and durability of the ram preventer's sealing elements, the basis for conducting experimental studies of their technical condition should be developed.To develop the basis for conducting experimental studies of the technical condition of the sealing elements of ram preventers in order to assess and predict their performance and durability. In this regard, for research, the main parts and components of the stand for testing standard drilling oilfield equipment were developed and manufactured. Structurally, the stand consists of two test wells with a depth of 2000 and 2500 meters, respectively. The structure of the wellhead equipment of each well includes a casing head with installed anti-blowout equipment (ram and annular hydraulic preventers together with a hydraulic drive station). A standard drilling rig and a rig for running a drill string into a pressurized well are installed at the test wellheads. In addition, the stand includes specially designed and manufactured additional components and assemblies: pumping units, suction and discharge manifolds, a circulation system equipped with a number of additional devices and mechanisms, etc. Moreover, an integrated hardware and software complex has been developed specifically for the stand for monitoring and recording information during experimental studies. This complex ensured fast processing of the results of experimental studies on a computer, reliable storage and retrospective access to data, quick readjustment and the possibility of parallel work with several test objects. It is a guide for the experimental study of the productivity and durability of the sealing elements of ram preventers and provides a set of measures for determining the technical condition of BOP during operation based on objective indicators.
Keywords: Blowout preventer, ram, preventer, sealing element, heavy-duty.

Current problem

The main directions of development of the country's fuel and energy complex are the main tasks of the industry: increasing the pace and efficiency of economic development based on accelerating scientific and technological progress, technical re-equipment and reconstruction of production, intensive use of production potential, and improvement of the management system.

At the same time, it is envisaged to ensure the production of a sufficient amount of oil, gas and gas condensate through the development of the industry by putting into development a large number of new oil and gas fields. Particular attention is paid to the development of drilling wells to depths of 5000-7000 meters or more in order to bring deep-seated deposits into development. An increase in oil and gas production is inevitably associated with the exploitation of new fields and productive horizons, the discovery of which depends on the degree of perfection of well drilling technology.

Experience shows that drilling to project depths is often accompanied by an increasing impact of hydrodynamic, physicochemical and mechanical processes occurring in the drilling fluid on the general state of the well-formation system. This ultimately leads to numerous complications and accidents.

In all types of known complications, it shows that under certain conditions, the creation of open gas and oil flows poses a special danger. These complications occur at many fields in the country, but manifest themselves with varying intensity depending on the specific technical and technological features of the drilling process and the geological situation of the area.

A scientifically based approach to the prevention and elimination of complications and accidents in the drilling process associated with gas, oil and water shows is the most important reserve for reducing well construction time and reducing their cost.

The choice of the most effective control of technological processes for the prevention and elimination of gas, oil and water intrusions is based on establishing the reliability, performance and durability of blowout preventer.

In this regard, the technical conditions of the sealing elements of ram preventers, which generally meet all the requirements for the normal performance of blowout safety tasks, is of paramount importance.

The work of many domestic and foreign authors is devoted to the study of the wellhead sealing process. However, most researchers usually paid attention to the influence of one factor - overpressure - on the reliability of wellhead sealing. A comprehensive study of the comparative effect of the solid phase, component composition and temperature of drilling fluids, storage and aging periods on the wear of sealing elements has not yet been carried out.

Purpose of work

Development and substantiation of a methodology for assessing the technical condition of the sealing elements of ram preventers to determine the performance and durability of blowout preventer equipment in real drilling conditions, which will ensure the flow safety of the work performed, as well as reduce unproductive time and material resources.

The main goals of the examine:

1. Analyze the reasons for the decrease in flow safety in the process of drilling and development of oil and gas wells due to the failure of the sealing elements of ram preventers.
2. Substantiate the basic requirements for the durability and performance of blowout preventer equipment to ensure flow safety.
3. To substantiate the need to predict the performance and durability of sealing elements of ram and ring preventers based on the results of experimental studies.

The article presents the scientific and methodological foundations for analyzing and evaluating the performance and durability of sealing elements of ram preventers based on the results of

qualification tests of blowout preventer equipment, taking into account real conditions and operating modes, as well as quality indicators of the material of sealing elements. Such an integrated approach makes it possible to apply computational methods both for assessing the situational situation and for developing measures to prevent and eliminate complications associated with gas, oil and water manifestations.

Mathematical models of wear of sealing elements of ram preventers during the performance of technological operations after sealing the wellhead have been developed and experimentally confirmed, which makes it possible to predict the technical condition of blowout preventer equipment at various stages of its creation and use.

An express method for assessing the technical condition of blowout control equipment in real conditions of the well drilling process is proposed, which allows, with minimal time and money, directly during the drilling process, to predict the moment of failure of sealing elements, taking into account their initial state.

A technique has been developed for assessing the performance and durability of the sealing elements of ram preventers, which will improve the flow safety of the drilling and development process, reduce the time for well construction in general, eliminate additional costs of materials and funds associated with the need to eliminate gas, oil and water manifestations and their consequences.

The proposed development can be used both for operational monitoring of the technical condition of the BOP equipment used in the drilling process, and for adjusting the technology in the drilling process.

The adopted mathematical models of the wellhead sealing process make it possible to implement the developed method directly on the drilling rig during drilling without additional testing of the sealing elements of ram and ring BOP’s. This makes it possible to carry out a predictive assessment of the proposed technological solutions, as well as to promptly correct the conduct of the processes for the elimination of gas oil and gas flows or open flows.

The problem of increasing the durability of standard drilling equipment was considered in the works of a number of authors, however, an analysis of studies devoted to this problem shows that the study of the causes and nature of failures of the main components of blowout control equipment is poorly covered in domestic and foreign literature.

To develop the basis for conducting experimental studies of the technical condition of the sealing elements of ram preventers in order to assess and predict their performance and durability. In this regard, for research, the main parts and components of the stand for testing standard drilling oilfield equipment were developed and manufactured. Structurally, the stand consists of two test wells with a depth of 2000 and 2500 meters, respectively. The structure of the wellhead equipment of each well includes a casing head with installed anti-blowout equipment (ram and annular hydraulic preventers together with a hydraulic drive station).

A standard drilling rig and a rig for running a drill string into a pressurized well are installed at the test wellheads. In addition, the stand includes specially designed and manufactured additional components and assemblies: pumping units, suction and discharge manifolds, a circulation system equipped with a number of additional devices and mechanisms, etc. Moreover, an integrated hardware and software complex has been developed specifically for the stand for monitoring and recording information during experimental studies. This complex ensured fast processing of the

results of experimental studies on a computer, reliable storage and retrospective access to data, quick readjustment and the possibility of parallel work with several test objects.

Until now, there are no methodological or normative-technical documents that would regulate the conduct of qualification tests or experimental studies according to the relevant plans, programs and methods.

The issues of predicting the technical condition of blowout preventer equipment are currently attracting more and more attention of oil and gas specialists in our country and abroad. This is due to the fact that in connection with the increasing depths of drilling and the correspondingly more complicated geological conditions of well drilling, the importance of increasing the flow safety and predicting the state of all drilling equipment is sharply increasing. Forecasting the performance and durability of sealing elements of blowout prevention equipment should be based mainly on the analysis of well sealing processes, special experimental studies and tests, and the study of the laws governing sealing processes that determine the formation of reliability indicators.

The methodology for solving this problem was based on the premise that the performance of the sealing element depends on the presence or absence of hydraulic connection between the cavities under and above the preventer rams, that is, on the presence or absence of hydraulic channels in the space between the drill pipe and the sealing element. The occurrence of these channels (wear) is due to the action of friction forces between the pipe and the elastic sealing element when the drilling tool moves through the closed preventer.

The presence of channels was determined in two ways:

- Direct - by fixing the wear of the sealing element.
- Indirect - by fixing leaks of drilling fluid (liquid) through the sealing element of the preventer.

These methods were used in carrying out experimental studies and testing of sealing elements in order to determine their durability, that is, the time interval during which they remain operational. In fact, experimental studies have revealed the parameters of the model for the formation of hydraulic channels in the sealing element of the preventer when walking along the smooth part of the drill pipe within the tool joint.

To determine the wear model of the sealing element, it was taken into account that the work expended on the destruction of the material of the sealing element is equal to the work of the friction forces when the body of the drill pipe moves through the seal for a certain period of time.

Table 1: Sizes and numbers of rams according to drill pipes

Type x size mm x MPa	Preparation	Drill pipe diameter	Number		
			ram	trunk	packer
476 x 70	Odd	193,7-88,9	614 879-01	614 846-01	615 569-01
476 x 70	Even	127-73,0	614 878-01	644 748-01	615 570-01
476 x 105	Odd	193,7-127,0	614 879-01	614 846-01	615 569-01
476 x 105	Even	127-88,9	614 878-01	615 845-01	615 570-01

Templates for U and UII preventers have been developed by "Cameron" company.

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Table 2: Rubber templates of "Cameron" company

Document number	Thread	Type of preventer	Usage
709 903	8 TPİ (EE) UN	U	Cap bolt, grooves in the preventer body and piston for changing plates, collar and nut pin
		U II	Cap pin, body splines, collar and nut pin, connecting rod end
709 904	4 TPİ ASME, kalibr	U II	Pins and nuts of the cover and piston for changing rams

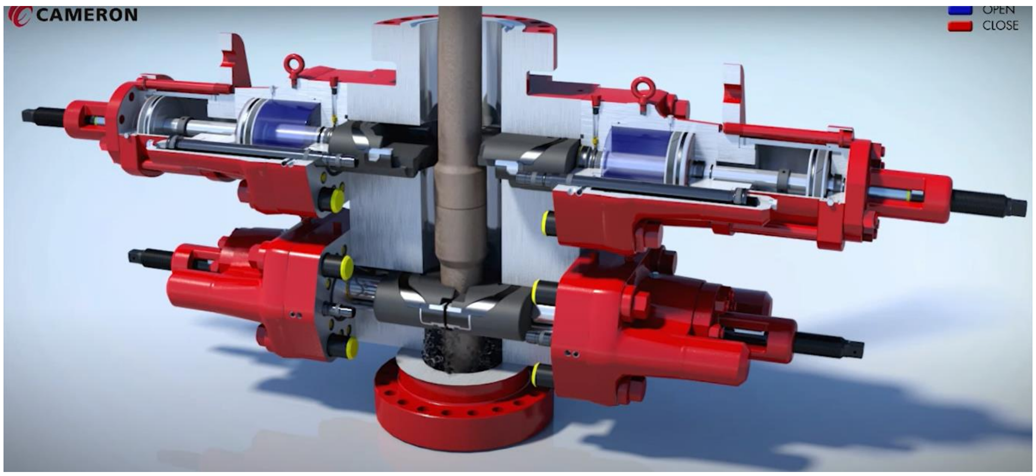


Figure 1: Shear BOP U – Cameron - U type preventer "Cameron" company.



Figure 2: BOP- Ram types

The solution of the inverse problem is important from the point of view of determining the performance indicators of the sealing element. Empirically (for example, when conducting qualification tests) for a given brand of sealing element, it is possible to establish the pressure value under the rams (in the well), at which the blowout preventer leaks. In other words, it is possible to determine the condition of the relationship between the pressure in the well, which squeezes the sealing element from the pipe, and the pressure in the preventer hydraulic drive,which creates a pressing forceof the element against the pipe.

The sealing element of a ram or annular BOP can be operated until the leakage rate of the drilling fluid according to standart reaches 4 l/min. From a technological point of view, it is important to be able at any time 1 to determine the resource of the sealing element, that is, to determine the time when it fails. This period of time can be determined by making the following assumptions:

1. Physically, the leakage of drilling fluid through the sealing element is the outflow of fluid through a narrow gap.
2. The pressure in the hydraulic drive depends on the wear of the sealing element.

Thus, the above models make it possible to determine the moments of the onset of leakage through the sealing element and its failure (loss of functional performance).

However, during the experiments, it was found that due to the large volume of fluid in the hydraulic control system and its insignificant changes during wear (the piston with the seal extends a small distance), it is difficult to control the pressure change process in the preventer hydraulic drive with sufficient accuracy. At the same time, control over the change in the effort (due to wear) of drill pipes spreading along their smooth part through the sealing element using modern highly sensitive wireline tension sensors turned out to be quite effective for determining the wear of sealing elements in order to assess their performance and durability.

Analytical models was determined for the dependence of the wear of the sealing element of the preventer on the time and speed of walking through it along the smooth part of drill pipes or, equivalently, on the path that the drill pipes pass in contact with the sealing element. The threshold value of the length of pipe reciprocation through the sealing element assumes a well-defined relationship between the dimensionless friction parameter and the dimensionless wear parameter. This ratio is individual for each specific batch of sealing elements. To determine the total length of pipe reciprocation through the sealing element, after which the leakage reaches 4 l/min (the element failed), a model of drilling fluid outflow through the gap between the pipe and the sealing element was determined. Similar experiments were carried out to determine the total length of drill pipe reciprocation through the sealing element until the sealing element completely failed (leakage 4 l/min).

Conclusion

In order to evaluate and predict the performance and durability of the ram preventer's sealing elements, the basis for conducting experimental studies of their technical condition should be developed.

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QAZMA PROSESİNİN FONTAN TƏHLÜKƏSİZLİYİNİ VƏ ATQIYA QARŞI AVADANLIĞIN KİPLƏNDİRİCİ ELEMENTLƏRİNİN İŞQABİLİYYƏTİNİN ARTIRILMASI

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XÜLASƏ

Məqalə neft-qaz istismarı zamanı quyu ləğvində və açıq fontanın qarşısının alınması üçün texnoloji proseslərdə,effektiv işqabiliyyətliyinə və uzunömürlüyə malikatqıyaqarşı avadanlığın müəyyənləşdirilərək seçilməsinə həsr olunmuşdur.
Bununla əlaqədar plaşkalı preventorların hermetikləşdirici elementlərinin texniki vəziyyətinin öyrənilməsi, plaşkalı preventorun fontan təhlükəsizliyinin tələblərindən irəli gələn bütünvəzifələrini normal yerinə yetirməsi birinci dərəcəli əhəmiyyət daşıyır. Plaşkalı preventorun kipləndirici elementlərinin iş qabiliyyətini və davamlılığını qiymətləndirmək və proqnozlaşdırmaq üçün onların texniki vəziyyətinin eksperimental tədqiqatlarının aparılması üçün əsaslar hazırlamalıdır. Bununla əlaqədar olaraq tədqiqat üçün standart qazma neft-mədən avadanlıqlarının sınaqdan keçirilməsi üçün sınaq stendinin əsas hissələri və komponentləri işlənib hazırlanmış və istehsal edilmişdir.Struktur olaraq stend, dərinliyi müvafiq olar aq 2000 və 2500 metr olan iki sınaq quyusundan ibarətdir. Hər bir quyu ağzı avadanlığının strukturuna atqıya qarşı avadanlığı quraşdırılmış qoruyucu başlıq daxildir. Sınaq quyularının ağzında standart qazma qurğusu və qazma xəttini təzyiqli quyuya aparmaq üçün qurğu quraşdırılmışdır. Bundan əlavə, stenddə xüsusi dizayn edilmiş və istehsal edilmiş əlavə komponentlər və birləşmələr daxildir: nasos aqreqatları, sorma və boşaltma manifoldları, bir sıra əlavə cihaz və mexanizmlərlə təchiz edilmiş sirkulyasiya sistemi və s. Bundan əlavə, eksperimental tədqiqatlar zamanı məlumatların monitorinqi və qeyd edilməsi üçün xüsusi olaraq stend üçün inteqrasiya olunmuş aparat və proqram təminatı kompleksi hazırlanmışdır.Bu kompleks eksperimental tədqiqatların nəticələrinin kompüterdə sürətli emalını, etibarlı saxlanmasını və verilənlərə retrospektiv çıxışı, tez tənzimləməni və bir neçə sınaq obyekti ilə paralel işləmək imkanlarını təmin edir.
Plaşkalı preventorların kipləndirici elementlərinin məhsuldarlığının və dayanıqlığının eksperimental tədqiqi üçün bələdçidir və obyektiv göstəricilər əsasında atqıya qarşı avadanlığın istismarı zamanı texniki vəziyyətinin müəyyən edilməsi üçün tədbirlər kompleksini nəzərdə tutulur.
Açar sözlər: Atqıyaqarşıavadanlıq, plaşka, preventor, hermetikləşdirici element, uzun ömürlülük.

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ПОВЫШЕНИЕ ФОНТАННОЙ БЕЗОПАСНОСТИ ПРОЦЕССА БУРЕНИЯ И РАБОТОСПОСОБНОСТИ ГЕРМЕТИЗИРУЮЩИХ ЭЛЕМЕНТОВ ПРОТИВОВЫБРОСОВОГО ОБОРУДОВАНИЯ

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РЕЗЮМЕ

Статья посвящена исследованию выбору наиболее эффективного управления технологическими процессами предотвращения и ликвидации газонефтеводопроявлений базируется на установлении надежности, работоспособности и долговечности противовыбросового оборудования.

В этой связи изучена техническое состояние герметизирующих элементов плашечных превенторов, которые в целом соответствуют всем требованиям нормального выполнения задач фонтанной безопасности, имеет первостепенное значение. Для разработки основ для проведения экспериментальных исследований технического состояния герметизирующих элементов плашечных превенторов с целью оценки и прогнозирования их работоспособности и долговечности. В этой связи для исследований были разработаны и изготовлены основные детали и узлы стенда поиспытанию стандартного бурового нефтепромыслового оборудования. Конструктивно стенд представляет собой две испытательные скважины глубиной 2000 и 2500 метров соответственно. В состав устьевого оборудования каждой скважины входит колонная головка с установленным противовыбросовым оборудованием (плашечный и кольцевой гидравлические превенторы вместе со станцией гидропривода). На устье испытательных скважин смонтированы стандартная буровая установка и установка для спуска колонны бурильных труб в скважину, находящуюся под давлением. Кроме того, в состав стенда входят специально спроектированные и изготовленные дополнительные узлы и агрегаты: насосные агрегаты, всасывающие и нагнетательные манифольды, циркуляционная система, снабженная рядом дополнительных устройств и механизмов, и др. Более того, специально для стенда разработан интегрированный аппаратно-программный комплекс для контроля и регистрации информации при проведении экспериментальных исследований. Этот комплекс обеспечивал быструю обработку результатов экспериментальных исследований на ЭВМ, надежное хранение и ретроспективный доступ к данным, быструю переналадку и возможность параллельной работы с несколькими объектами испытаний. Он является руководством по экспериментальному исследованию производительности и долговечности уплотнительных элементов противовыбросовых превенторов и содержит комплекс мероприятий по определению технического состояния противовыбросового превентора в процессе эксплуатации по объективным показателям.

Ключевые слова: Противовыбросовое оборудование, плашка, превентор, герметизирующий элемент , долговечность.

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INVESTIGATION AND RELIABILITY IMPROVEMENT OF ROD DOWNHOLE PUMP VALVE ASSEMBLY

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ABSTRACT

The purpose of the work: modernization of the valve, in order to increase reliability, wear resistance, increase the pump flow and reduce the load on the rod string. As well as improved durability. Object of work: Rod pump valve.
Realization of the goal is achieved by performing the following tasks:
1. Overview of known designs of the valve assembly of a sucker rod pump;
2. Identification of a number of causes of valve failure, as well as its causes of wear;
3. Calculation of the main parameters of the pump;
4. Overview of the design of a sucker rod pump, to understand the problem;
5. Development of measures for the maintenance and repair of the pump.
In the course of the WRC, a review and analysis of information on the designs of the valve assembly of a borehole rod pump was carried out. The problem of its wear has been studied. The problem of valve design is formulated and solved.
At the moment, sucker rod pumps (SRP) and electric submersible pumps (ESPs) are used. Since the ESP has much higher production capabilities compared to the rod, the main volume of oil in the country is produced using ESP units.
In view of the fact that the simplicity of the design of the SRPU is the most maintainable during practical operation, it is precisely such installations that are used at the moment. And also the positive aspects of the SRPU are the convenience of its adjustment, the small effect on the operation of the SRPU of the physical and chemical properties of the pumped liquid, the relatively high efficiency and the possibility of operating wells of small diameters, compared with other installations and methods of operation.
However, SRPU oil production is based on relatively old oil production technology and techniques, especially for downhole and downhole equipment and technological operations carried out using this equipment.
The development, manufacture and testing of new equipment is becoming especially relevant.
The purpose of my project is to increase the filling factor of a sucker rod pump, as well as to increase the reliability of its operation after repairs. An increase in the filling ratio of the SRP is achieved by upgrading the valve assembly, and an increase in reliability.
Keywords: sucker rod pump, valve part, abrasion, reliability, downhole pump, suction valve, discharge valve.

Introduction

General information about the borehole rod pump. A downhole rod pump is a single-acting pump, which is driven by reciprocating movements with the help of a pumping unit from the engine, by

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means of the movement of the rod string. Rod downhole pumps are designed for pumping oil-containing liquid from oil wells.

The pumps are a single-action vertical plunger design with ball valves, fixed cylinders and metal plungers; they descend into the well on a column of lifting pipes and pump rods. The reciprocating movement of the plunger is transmitted by the rocking machine through a column of pump rods. The column bar is suspended on the head of the balancer of the rocking machine by means of a rope suspension. The pumping mode (the length of the stroke of the polished rod and the number of double strokes of the machine-pump) is set depending on the amount of liquid being lifted.

Classification of rod well pumps. Pumps are classified according to the size of the diameter, according to the size of the gap between the plunger and the cylinder (group of landings), according to the type of pump, according to the design.

Sucker rod pump (SRP) is a positive displacement hydraulic machine, where the seals between the plunger and the cylinder are achieved due to the high accuracy of their working surfaces and regulated clearances. Depending on the size of the gap (per diameter) in the cylinder-plunger pair, pumps of five groups of landings are produced.

The principle of operation of a borehole rod pump. A downhole rod pump consists of a plunger that moves up and down a cylinder in a hermetically sealed manner. The plunger has a non-return valve (discharge) in its design, which allows fluid to flow up, but not down. In modern pumps, it is a saddle-ball pair. There is also a suction valve, which is adapted so that the liquid does not flow downwards, but is allowed to flow upwards, similar to a discharge valve. This valve is located at the bottom of the pump.

The operation of the pump is as follows. Initially, the plunger is in a stationary state, at the bottom of the stroke. Both valves are closed. When the plunger moves down, the suction valve opens. Under pressure, the ball rises and liquid enters the cylinder, the valve closes. When the plunger moves up, the discharge valve opens and the liquid moves up, then the check valve closes. The work is repeated cyclically.

Relevance

The relevance of this work is to improve the valve assembly in order to increase its durability, reduce hydraulic resistance, and increase the wear resistance of the valve.

Determine the wear to which the valve is subjected. Apply corrosion protection measures. The main units of the SRPU include a cylinder, a plunger, a valve assembly and a lock support.

The valve does the job of temporarily isolating the bottom of the well pump. This part of the pump receives liquid from the tubing. The valve is more subject to wear than other pump components.

Depending on the design of the pump, the discharge valve can be installed both at the top and at the bottom of the plunger, or occupy both positions at the top and bottom. The lower the hydraulic resistance of the valve, the less likely it is that additional force will appear when the rods move down.

Purpose of work

General scheme of a borehole rod pump. A rod pump is a specially designed plunger pump driven from the surface by a rod (Figure 1).

A suction valve 1 is installed at the bottom of the pump. The pump plunger, equipped with a discharge valve 2, is suspended on a rod 3. The upper part of the rod is passed through the wellhead stuffing box 5 and connected to the head of the balancer 6 of the pumping unit. With the help of the connecting rod mechanism 7, the head 9 of the balancer provides reciprocating motion to the rod 3 and the plunger.

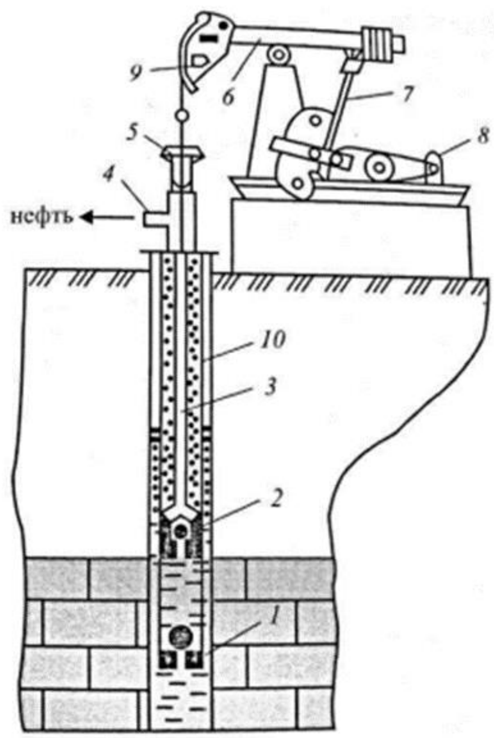


Figure 1: Scheme of oil production using a rod pump: 1 - suction valve; 2 - discharge valve; 3 - rod; 4 - tee; 5 - wellhead gland; 6 - balancer of the pumping unit; 7 – connecting rod mechanism; 8 - electric motor; 9 - balancer head; 10 - pump pipes.

There are three types of pumping units: balancing, hydraulically driven and pneumatically driven. The most common are balancing pumping units. The main advantages of balancing pumping units (SK) include ease of installation and maintenance, long periods of operation, low cost of components and the product as a whole. Mobility and lower metal consumption, in comparison with mechanical SC, cause a reduction in time and material costs for the installation of the drive. The presence of advanced telemetry and control systems allows for a comprehensive assessment of the "drive-well" system and change the parameters of the hydraulic drive in a wide range.
The disadvantages of rod pumps are bulkiness, limited use in inclined wells, low flow and small - up to 3000 m operating depth.
The mouth of the sucker-rod pumping well is equipped as follows (Figure 2). A faceplate 2 with tubing 3 suspended from it is attached to the column flange 1. A tee 5 is screwed into the coupling 4 to drain oil and to bring out the wellhead rod 7, which connects the pump rods with the head of

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the balancer of the pumping unit through a cable suspension. The outlet of the wellhead rod is sealed with a stuffing box.
If necessary, a sand or gas anchor is equipped in the lower part of the pump. It is designed to separate sand from formation fluid.
The electric motor transmits energy through the gearbox to the connecting rod mechanism. The connecting rod mechanism converts the rotational movement of the output shaft of the gearbox through the balance bar into the reciprocating movement of the rod string. The plunger also reciprocates. When the plunger moves up, the discharge valve is closed by the pressure of the liquid that is above it, and when the liquid moves up in the tubing string, the liquid is pumped out. At this time, the inlet (suction) valve opens, and the liquid fills the volume of the pump cylinder under the plunger.

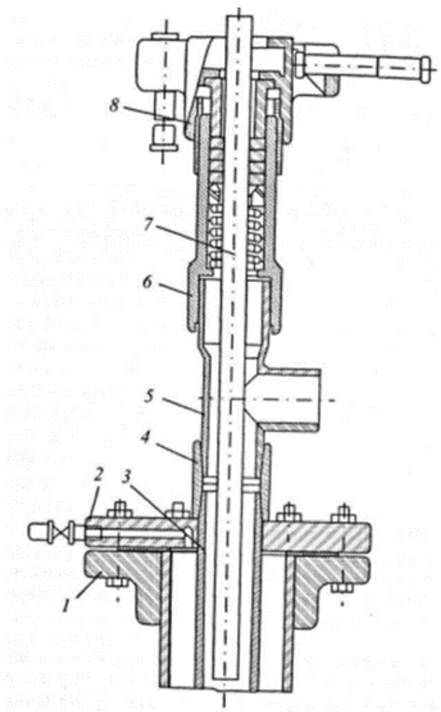


Figure 2: Wellhead equipment operated by a rod pump: 1 - column flange; 2 - faceplate; 3 - tubing; 4 - clutch; 5 - tee; 6 - stuffing box; 7 - wellhead stock; 8 – cover.

The tubing string is designed to lift formation fluid to the surface and to connect the wellhead equipment with the downhole pump cylinder. Seals the tubing gland, installed in the upper part of the column. A polished rod is passed through the stuffing box. The pumped liquid moves into the production network through the outlet in the wellhead equipment. Common designs of rods do not meet the conditions of equal strength under operating conditions during reciprocating movement in the well. The reason is, among other things, the high concentration of stresses in the heat-affected zone, due to the technology of forming the head in the process of manufacturing the RP. The cyclicity of stresses leads to their accumulation and the appearance of a fatigue crack.
When the plunger moves down, the suction valve is pressurized the pumped liquid column closes, the discharge valve opens and the liquid flows into the over-plunger space of the cylinder.

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Ball valves. Ball valves are the most common, as they allow you to increase the reliability of operation and are easy to manufacture. But even such valves have their shortcomings.
Pump valves can be distinguished by the design of the valve seat: with a cylindrical seat and a cylindrical seat with a shoulder (Figure 3).
Both designs are available with normal and reduced ball diameters.

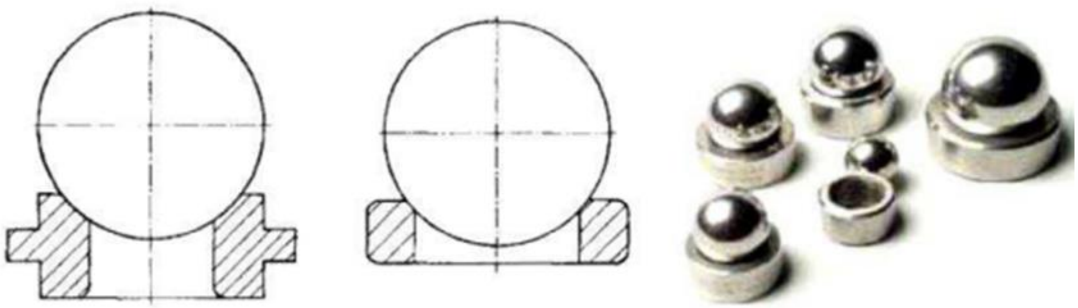


Figure 3: Design of valve seats

The sealing of the valve and the duration of its operation directly depends on the shape of the valve seat. Practical application made it possible to understand that all types of front surfaces become spherical in the process of work with a radius equal to the radius of the ball.
The durability of using ball valves is explained by the lapping of the ball in the seat during operation and the relatively large active surface of the ball.
Criteria to be met by the valve:
1) The mass of the saddle must be the largest possible, and the ball the smallest possible. This can be achieved by reducing the diameter of the ball or by reducing its weight;
2) The flow area of the valve should be as small as possible to reduce flow resistance;
3) The strength of the ball must be lower than the strength of the seat in order to
prevent its collapse under the action of repeated blows of the ball;
4) The hardness of the seat must be lower than the hardness of the ball, in order for the ball to retain its shape and original surface condition during operation.
Consider the main causes of valve wear:
1) Corrosivity of the environment;
2) Abrasiveness, due to the presence of sand;
3) Deformation, since when the ball is seated in the saddle, it is subjected to numerous shocks;
4) Mechanical wear is due to seat and ball friction.

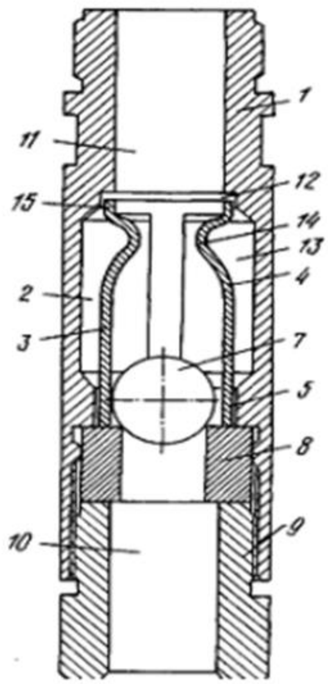


Figure 4: Valve design

Figure 4 shows the ball valve of a deep well pump, invented by AzZNIPIneft. Consider the operation of this ball valve. With the appropriate stroke of the plunger of the deep pump, the valve opens, and the liquid flows from the sub-valve cavity 10 to the supra-valve cavity 11. When the plunger moves back, the valve closes.

At the moment of opening the valve, the ball 7 hits the internal projections 14 of the elastic vertical ribs 4 of the guide device 3, and then, under the action of the fluid flow, begins to perform rotational-oscillatory motion in the horizontal and vertical directions.

The disadvantage of this design of the valve is the guiding device, which is not manufacturable and requires special equipment. And also there is a swirling of the liquid - when the pumped liquid flows from the sub-valve cavity into the supra-valve cavity in the zone of the cylindrical recess, the liquid meets the resistance of other vertical edges of the guide device, made of a flat shape.

Conclusion

The improved valve in operation makes it possible to significantly increase the cross-sectional area of the valve seat and, consequently, reduce its hydraulic resistance. The lower the hydraulic resistance of the valve, the less likely it is that additional force will appear when the rods move down.

The durability of using ball valves is explained rubbing of the ball in the seat during operation and a relatively large active surface of the ball. The presented valve improves reliability, thereby reducing pump failure, which can occur due to the failure of the suction valve assembly by the flow of the pumped liquid or its inadvertent capture by the plunger.

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ŞTANQLI QUYU NASOSUNUN KLAPAN DÜYÜNÜNÜN TƏDQİQİ VƏ ETİBARLILIĞININ ARTIRILMASI

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XÜLASƏ

İşin məqsədi: etibarlılığı artırmaq, yeyilməyə qarşı müqavimətini artırmaq, bununla da nasosun verilib artırmaq və ştanqa düşən yükü azaltmaq üçün klapanın təkmilləşdirilməsi. İşin obyekti: quyu ştanqlı nasosun klapanı.

Bu məqsədin həyata keçirilməsini aşağıdakı vəzifələri yerinə yetirməklə əldə etmək olar:
1. Quyu ştanqlı nasosun mövcud klapanı düyününün araşdırılması;
2. Klapan düyünündə baş verən nasazlıqların bir sıra səbəblərinin müəyyən edilməsi;
3. Nasosun əsas parametrlərinin hesablanması;
4. Problemi başa düşmək üçün quyu ştanqlı nasosa ümumi baxış;
5. Nasosun saxlanması və təmiri üçün tədbirlərin hazırlanması.
Bu tədqiqatda bir quyu ştanqlı nasosun klapan düyününə dair məlumatlar nəzərdən keçirilir və təhlili aparılır. Burada onun aşınma problemi tədqiq edilir. Klapanın düyününün yeni modeli formalaşdırılır və yeyilməyə qarşı davamlılıq məsələləri həll edilir.
Hal hazırda ştanqlı quyu nasosları (QŞN) və elektrik dalma nasosları neftin çıxarılmasında istifadə edilir. Bu qurğulardan istifadə etməklə ölkədə neftin əsas həcmi istehsal olunur.
QŞN qurğularının konstruksiyasının sadəliyi və praktik istismar zamanı davamlı olduğunu nəzərə alaraq, hazırda bu qurğulardan geniş istifadə olunur. Həmçinin ştanqlı quyu nasosunun müsbət cəhətləri onun tənzimlənməsinin rahat olması, vurulan mayenin fiziki-kimyəvi xassələrinin bu nasos qurğularının işinə kiçik təsiri, nisbətən yüksək məhsuldarlıqlı və kiçik diametrli quyuların istismarını həyata keçirməsinə imkan verməsidir.
Lakin ştanqlı quyu nasoslarının köməyi ilə neftin hasil edilməsi nisbətən köhnə neft hasilatı texnologiyası və texnikası əsasında texnoloji əməliyyatları həyata keçirməyə imkan verir.
Bu işdə avadanlıqların inkişafı, istehsalı və sınaqdan keçirilməsi xüsusi ilə aktuallaşdırılır.
İşin əsas məqsədi ştanqlı quyu nasosunun məhsuldarlığının, həmçinin təmirdən sonra onun iş qabiliyyətinin və etibarlılığının artırılmasıdır. Ştanqlı quyu nasoslarında məhsuldarlığın artması klapan düyününün təkmilləşdirilməsi və etibarlılığının artırılması ilə əldə edilir.
Açar sözlər: ştanqlı quyu nasosu, klapan düyünü, yeyilmə, etibarlılıq, quyudibi nasos, sorma klapanı, vurma klapanı.

ИССЛЕДОВАНИЕ И ПОВЫШЕНИЕ НАДЕЖНОСТИ УЗЛА КЛАПАНА ШТАНГОВОГО ЗАГРУЖАЮЩЕГО НАСОСА

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РЕЗЮМЕ

Цель работы: усовершенствование клапана, с целью повышения прочности, надежности, увеличению производительности насоса и уменьшению нагрузки насоса. А также повышение работоспособности клапана насоса.
Для достижения цели проводится решения нижеследующих задач:
1. Изучение известных конструкций клапанов скважинного штангового насоса;
2. Выявление ряда причины износа, причины выхода из строя штанга;
3. Расчет некоторых параметров насос;

4. Расчет узлов штангового насоса, для исследовании отказа;
5. Применение мероприятий по ремонту и обслуживанию штангового насоса.

В ходе решения был проведен анализ данных и изучение клапанов скважинного штангового насоса. Исследовано проблема его отказа. Изучена и решена пути по комплектовании клапана.

В нефтепромысловом хозяйстве используются штанговые глубинные насосы и электроцентробежные насосы. Из-за того, что электроцентробежные насосы имеет гораздо высокие добычные возможности по сравнению со штанговой, почти основной объем нефти в промышленности добывается с помощью этих установок.

У штанговых глубинных насосов простая конструкция, поэтому они являются ремонтопригодными во время эксплуатации, именно эти насосы используются на данный момент. А также положительными аспектами штанговых насосов является удобство её установки, меньшее влияние на работу насосов физико-химических свойств откачиваемой скважинной жидкости, относительно высокий работоспособность и возможностью при работе скважин разных диаметров, по сравнению с другими устройствами и видами эксплуатации.

Несмотря на это, добыча нефти с помощью штанговых насосов производится на базе давнейшей устройств технологии и техники производства нефти, тем более это относится к разным операциям, скважинному и внутрискважинному конструкциям и проводимым с помощью этих конструкций.

Особенно актуальной становится изучение и испытание нового клапана.

Целью этой статьи является увеличение производительности наполнения штангового скважинного насоса, а также увеличение работоспособности его узлов после проведения ремонтов. Увеличение производительности наполнения штанговых насосов достигается усовершенствование клапанного узла.

Ключевые слова: штанговые глубинные насосы, узел клапана, истирание, надежность, скважинный насос, всасывающий клапан, выпускной клапан.

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SUBMERGED ARC WELDING AND MELTING TECHNOLOGY

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ABSTRACT

The article dedicated "Submerged arc welding and meltıng technology" method, which is one of the technologies for repairing friction-worn parts of oil and gas equipment.
The efficiency, technological regime,advantages of the process are noted, and it is also shown that this method is used today in the oil industry and shipbuilding.
With these methods, the repairing of a part of the pieces corroded by friction, as well as the possibility of welding steel plates of different grades and thicknesses, was reflected.
In determining welding procedures for certain applications, the welding engineer must first take into account the specific welding qualities required, since in practice, although some factors can be determined quite accurately, others change during manufacturing process.
Arc voltage, electrode selection, welding speed are important considerations in determining operating mode, and the penetration caused by high voltage combined with low speed is indicated accordingly.
The supply of agent (glycerin) to the recently created attachment zone is indicated. It reduces the thermal impact of the cooling arc on the half and will increase the cooling rate of the deposited and metal, decreasing the deformation and self-heating of the adjacent elements of the half. Besides, the liquid serves to safeguard the liquid metal from the harmful effects of chemical element and gas.
Keywords: overheating, vibration, crack, arc voltage, welding defects, welding speed, technical glycerin, soda ash.

Urgency of the work

The purpose of submerged arc welding is a process that pops up coating with a powder flow from a continuously supplied arc welding electrode wire,adding a molten electrode to the surface. This process is used in modern industry for welding steel metals of different composition to each other and restoring some equipment, corroded by friction. Vibro-arc welding is based on the methods of contact of surface metals and electric arc. Essence of this method lies in the fact that during surfacing the electrode is given vibrations with a frequency of 50-100 per/s, and the process is carried out using a mechanical vibrator. Mechanical vibrating bars can supply with different vibration frequencies depending on their design. As a result of electrode vibration during surfacing, arcing cycles and short circuit cycles alternate.1 An arc with a voltage of 2 ... When surfacing, a cooling powdery substance is supplied to the arc zone - 5% soda ash. Soda ash - technical glycerin (sodium carbonate) and its chemical formula - Na_2CO_3. adjoining part reduces deformation and self-heating of pieces. Soda ash is referred to in some literature as a flux, technical glycerin or sodium carbonate.
The liquid aid to preserve the molten metal from the harmful effects of oxygen and nitrogen. The electrode, which is a combs of essential material of the main parts, a flux additive, a molten flux

and a contact vibrating rod, forms a special arc that can reduce any smoke, fumes and radiation during process that is not observed This factor is noted as one of the most positive aspects of the vibration polishing process in the field of production. Technological surfacing has significant preferences over other methods of restoring worn parts. These benefits include:
• Small deformations of the parts must welded.
• Shallow depth of the heat area.
• Obtaining deposited layers of increased hardness without additional treatment.
• Possibility of coating thin layers.
These preferences have led to the widespread use of the shown method for the restoration of pieces, especially for the restoration of automobile and tractor parts, parts of agricultural machines, electric motors, various industrial and mining equipment, ship mechanisms and machines.
The proximity of the contact and the wire feed mechanism to the arc allows the use of large diameter wire up to 6 mm, although smaller diameter wires of less than 1 mm, similar to those used in welding of metals, can also be used. Accordingly, a huge range of welding currents is probable, allowing welding of metal with a thickness of 3 mm to 100 mm or more. The current method is most commonly used for iron and stainless steel welds, and additional copper-based alloys are also suitable for titanium.This technique may be a productive method that enables getting high-quality welds in a very wide selection of thicknesses of metallic element and stainless steel addition even some non-ferrous metals. One among the few limitations of vibrating egression technology is that each one fastening should be drained a horizontal/vertical or flat position.

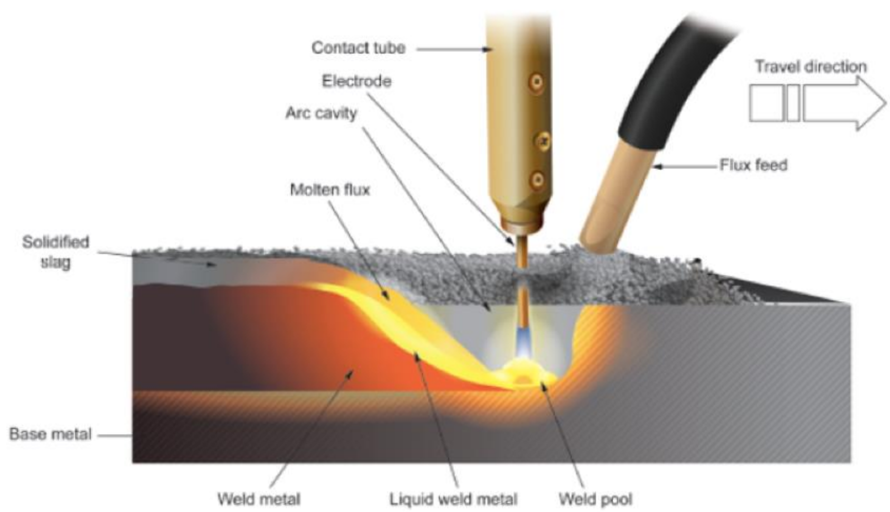


Figure 1: The Submerged Arc Welding Process

Vibro-arc coating is used mainly for the restoration of parts made of steel materials, medium-carbon and low-carbon alloys, for heat-treated parts of complex configuration, where deep heating occurs, heating of the hardened surface and bending of the part are unacceptable.

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General procedures

When determining welding procedures for certain methods, engineer must first consider the specific weld qualities required, such as hole, weld surface profiles, mechanical properties, etc. The appropriate argument are then selected and are expected to produce weld seam conforming to these standards. In theory, there is direct control over a large number of input variables. In practice, while some factors could determined fairly accurately, others change during the production process. Limits for such variations can be set, but exact parameters cannot be maintained. Welding circumstances picked as per experience may give satisfactory results, but there is no guarantee that optimum production speed, process and tolerances will be strived. Such confidence can only arise against the backdrop of quantitative process data.

Arc voltage

The arc voltage has an essential effect on the shape of the weld, creating a larger diameter weld. The arc voltage changes in proportion to the length of the arc. As the arc length increases, its voltage increases and, consequently, the ratio of heat used to melt the electrode and base metal increases. As a result, the width of the seam and the depth of hole enhance. Welding is best done with a short arc, where the voltage is set to 18-20 V. A long arc makes a sharp sound and is accompanied by a significant splash of molten metal. To decrease the length of the arc, the electrode holder with the electrode must lowered faster. The forms of various arc voltages created by the action of the welding wheel are shown in below.

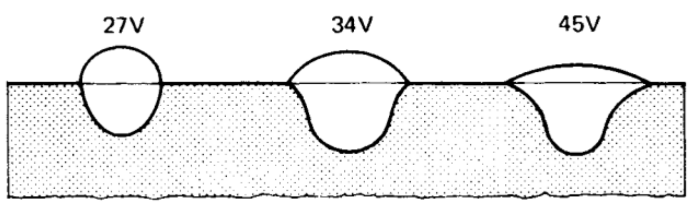


Figure 2: At different arc voltages shape of the welds

Welding speed

The size of the weld is inversely proportional to the welding speed at the same current. Higher speeds decrease the width of the weld diameter, increase the likelihood of porosity and, if pushed to the limit, create inverted and irregular bubbles. At high welding speeds, the arc voltage must be kept low or arc flash may occur. If the welding speed is too low, sticking may occur. The unification of high arc voltage and low welding speed can outcome in a mushroom weld with hardening cracks on the overlapped sides. During exceptional moments, special composite electrodes are used for high-speed operation. Mushroom hole of a weld resulting from high voltage united with low speed is shown in below.

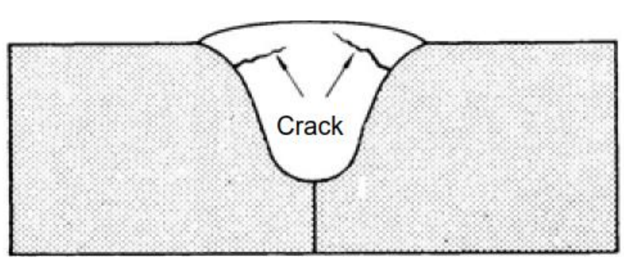


Figure 3: A crack formed during the welding process

Weld defects

The varieties of defects detected throughout scrutiny internal and external. All efforts to enhance productivity should begin with a all-around valuation of the whole production before and once the attachment stage. the most surface defects cracks, pores and crusts, dross inclusions, non-adhesion of the layer with the bottom metal, tears within the space of reference to the metal of the half. Factors like material, melt flow, and work on thanks to defects should examined and any bottlenecks in production noted. solely then ought to attention be paid to the small print of the attachment method. attachment faults like dangerous weld form, lack of merger, dross inclusions and consistence typically prevented by not following correct attachment procedures. In multi-pass welding, proper positioning of the welding wheels is essential to avoid deep narrow gaps between the welding wheels and the surfaces where slag can accumulate. Some defects are not directly related to welding conditions, so good cleanliness is also important, especially flux, wire and weld preparation. The formation of cracks depends on the amount of carbon and sulfur in the deposited metal, insufficient heating of the part during surface coating, the hardness of the product, etc. it depends. If cooling of the part is delayed after coating, cold cracks may occur. ASME B31.3 provides extensive information under the heading "Post Weld Heat Treatment and Defects (PWHT)".

The porosity faults is a much more total defect. Usually it is distinctly apparent on the surface of the weld, other times it is below the surface and can only be detected using Ultrasonic Testing (UT).

Main reasons of porousness defects include:

1. Oil, paint, wet oxides, etc. Melted surface and the surfaces to be joined. They break down in the arc to form gasiform products which can frequently cause porosity along the center line of the weld.

2. Wet Flux: The molten chemical mixture (flux or electrode) must be left dry. All fluxes and electrodes must be dried before use and stored in a heated area. The manufacturer's recommendations on the drying temperature should be expected, which in all options is mentioned in the technical data sheet of the equipment. It should be mentioned that if a recuperation part with controlled compressed air flow is used, the compressed air must be well dried.

3. Uneven movement of the electrode, drum converter, consequently in the height and breadth of the weld differing in stretch.

4. Porosity created by hydrogen

Some steels square measure a lot of sensitive to hydrogen-induced porousness than others, wave attachment isn't notably liable to this sort of defect. If the steel has high hardenability, the carbon equivalent is beyond 0.40%, and therefore the flux (molten electrode) is wet, porousness and cracking will occur. Necessary factors in preventing porousness square measure the employment of unpolluted and dry flux to reduce hole into the weld. It should be necessary to regulate the scale of the weld, maintaining the minimum house necessary to avoid hardening of the weld zone. If uphill, preheating is also demanded to unleash enough from the weld to preserve cracking.

Main application areas

Work widely used in the petroleum industry and machinery in the increasing of worn parts (where recovery is possible), tractor wheels, cylindrical shafts, crane pulleys. Totally used in thick steel for application metal structures. Although process is related to welding, it also plays an important role in high-speed automatic welding of smaller and thinner components. Although the vibrating top melting process is designed to automatically weld heavier sections of steel plate, the semi-automatic version has been in use for many years and was the first widely used semi-automatic arc welding system. While this process is created for automatic welding of heavier part of steel plate, a semi-automatic version has been in use for many decades. At first, in a semi-automatic version, the flux (cooling ash) was ejected from a small drum mounted on a hand-held device into which a wire was fed, but the mechanized flux supply after modernization raised the mobility of process with remote control.

Conclusion

In their study, researchers used submerged arc vibration attachment method supported numerous attachment input parameters, input attachment current, voltage, attachment speed, weld microstructure, hole, width, and height.

It has been better-known from experimentation that a seam or a brand new surface layer are often created on steel and stainless steel as per quality and repair needs.

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АВТОМАТИЧЕСКАЯ ДУГОВАЯ СВАРКА ПОД ФЛЮСОМ

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РЕЗЮМЕ

В статье рассмотрен метод "технология вибрационного шлифования и сварки", который является одной из технологий восстановления деталей, изношенных трением в нефтегазовом оборудовании.
Указана эффективность, технологический режим и преимущества процесса. Также показано, что данный метод успешно применяется сегодня в нефтяной промышленности и судостроении.
С помощью этих методов было отражено восстановление некоторых деталей, изношенных трением, а также возможность сварки стальных листов различных марок и толщины.
При определении методов сварки для определенных областей применения инженер-сварщик должен в первую очередь учитывать конкретные требуемые качества сварки, ведь на практике, хотя некоторые факторы могут быть определены достаточно точно, другие меняются в процессе производства.
Было отмечено, что напряжение дуги, выбор электрода и скорость сварки являются важными условиями при определении технологического режима. Соответственно, указано проплавление сварочного шва, вызванное высоким напряжением в сочетании с низкой скоростью.
Показана подача охлаждающей жидкости (технический глицерин) во вновь созданную зону сварки. Она снижает тепловое воздействие дуги на деталь и увеличивает скорость охлаждения наплавленного и основного металла, тем самым уменьшая деформацию и саморазогрев прилегающих частей детали. Кроме того, жидкость служит для защиты расплавленного металла от вредного воздействия кислорода и азота.
Ключевые слова: шлифование, вибрация, трещина, напряжение дуги, дефекты сварки, скорость сварки, технический глицерин, кальцинированная сода.

TİTRƏMƏ ÜSULU İLƏ ÜSTƏRİTMƏ VƏ QAYNAQ TEXNOLOGİYASI

Rüstəm Abaszadə
Dəniz Boru kəmərlərinin Layihələndirilməsi Mühəndisi, Boru Kəmərinin Layihələndirilməsi, SOCAR-KBR MMC. Avadanlıqların möhləmliyinin artırılması və təmiri üzrə Magistr, Azərbaycan Dövlət Neft və Sənaye Universiteti. Email: rustam.abaszada@gmail.com

XÜLASƏ

Məqalədə neft və qaz avadanlıqlarında sürtünmədən yeyilən detalların bərpa texnologiyalarından olan “Titrəmə ilə üstəritmə” üsulu nəzərdən keçirilib.

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Prosesin səmərəlilİyi,texnoloji rejimi və üstünlükləri qeyd olunub.Həmçinin cari metodun bugün neft sənayesində və gəmi tikintisində uğurlu tətbiq olunduğu göstərilmişdir.
Bu metodlarla sürtünmədən yeyilən detalların bəzilərinin bərpası,həmçinin müxtəlif markalı və qalınlıqlı polad lövhələrin qaynağının mümkünlüyü öz əksini tapmışdır.
Müəyyən tətbiqlər üçün qaynaq prosedurlarını təyin edərkən, qaynaq mühəndisi ilk növbədə tələb olunan xüsusi qaynaq keyfiyyətlərini nəzərə almalıdır.Çünki təcrübədə, bəzi amillər kifayət qədər dəqiq müəyyən edilə bilsə də, digərləri istehsal zamanı dəyişir.
Texnoloji rejimin təyini zamanı qövs gərginliyi,elekrod seçimi və qaynaq sürətinin vacib şərtlərdən olduğu qeyd olunub.Uyğun olaraq aşağı sürət ilə birləşən yüksək gərginliyin əmələ gətirdiyi qaynaq nüfuzu göstərilmişdir.
Yeni salınmış qaynaq zonasına soyuducu maye verilməsi (texniki qliserin) qeyd olunub. Soyuducu qövsün hissəyə istilik təsirini azaldır və çökdürülmüş və əsas metalın soyutma sürətini artırır, bununla da hissənin qonşu ətraflarının deformasiyasını və özünü istiləşdirilməsini azaldır. Bundan əlavə, maye ərimiş metalı oksigen və azotun zərərli təsirlərindən qorumağa xidmət edir.
Açar sözlər: üstəritmə, titrəmə, çat, qövs gərginliyi, qaynaq qüsurları, qaynaq sürəti, texniki qliserin, soda külü.

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DYNAMICS OF DECOMPOSITION OF SOLID HOUSEHOLD WASTE IN THE PRESENCE OF SULFURIC ACID

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ABSTRACT

The article is devoted to the development of technology for obtaining organic-mineral fertilizers and chemical meliorants on the basis of solid waste (SW). The presented article mainly describes the physico-chemical basis of decomposition of solid waste with solutions of different percentages of sulfuric acid, which is the first stage of the study. The purpose of the research is to study the physico-chemical basis of decomposition of solid waste depending on the concentration of sulfuric acid solution, its initial temperature, time and intensity of mixing during the development of technology for obtaining organic-mineral fertilizers and ameliorative substances.

During the study, the concentration of sulfuric acid solution from 5% to 70, decomposition dynamics of samples within 36-80 minutes, It was studied under mixing conditions at an intensity of 40 per/min to 180 per/min. It was established that each factor has a great influence on the percentage of decomposition of solid household waste, therefore, the optimal parameters for each factor were determined and clarified as a result of experimental experiments.

As a result of the conducted research, it was determined that solid waste from the point of view of the richness of macro-and microelements contained in it is a fully usable raw material for fertilizer production, it has been observed that the extraction of food-repellent elements from the composition of solid household waste with 10-20% sulfuric acid solution is appropriate and in this case, along with the decomposition, the process of neutralization of microorganisms in it takes place. 40-60^{0}C optimum temperature of technological process for transition of moisture-repellent elements into solution, it has been proved that the concentration of acid solution is between 10-20% and the mixing intensity is 60-140 per/min., in the end, it is recommended to enrich the composition of the obtained fertilizer with nutritive substances after the completion of the technological process in order to improve the quality of the composition of the obtained liquid fertilizer.

As a result of the conducted studies, it was found that during the decomposition of solid waste in the presence of weak acid solutions, about 80-85% of the nutrient elements contained in it can be extracted and used in fertilizer production.

Key words: fertilizer, solid waste, sulfuric acid, ameliorant, salinity, salinization.

Introduction

Over the past thirty years, the rapid development of the Republic, mainly the development of industry and agriculture, has been sharply noticeable. This development gave an impetus to the growth of the population and, in turn, the development of construction sites. It is known that the growth of the population puts the issues of improving their food supply and living conditions at the forefront and makes them relevant. The main waste generated as a result of this development is solid household waste generated in large quantities in the territory of the Republic [1-5,8]. As a result of recent studies, it has been established that the SW contains most of the nutrients necessary for the normal development and growth of agricultural crops. As a result of the analysis of the chemical composition and the data obtained, it was concluded that it is a valuable raw material [6,7,9]. The use of it as a raw material in the production of organic-mineral fertilizers will solve the problem of food security of the population of the Republic set by the state, and also have a very positive impact on the solution of environmental problems of the territory of the Republic, which is one of the most important and relevant issues in terms of [10].

The purpose of the research

The study of the physico-chemical basis of decomposition of solid waste depending on the concentration of sulfuric acid solution, its initial temperature and time during the development of technology for obtaining organic-mineral fertilizers and ameliorative substances.

The current state of the problem. After the collapse of the Soviet Union, "Sumgait superphosphate plant", the only fertilizer plant in the Republic, ceased its activity. The reason for this was the lack of raw materials for the production of fertilizer in the territory of the Republic and its import from abroad. Since it was not economically viable, it was not convenient to bring apatite from the territory of Russia, which is the main raw material for obtaining fertilizer. For this reason, since 1990, all types of fertilizers required for agriculture have been imported into the Republic from abroad, which leads to an increase in the cost of manufactured products. The opening of a carbamide plant in Sumgayit a few years ago partially contributed to the solution of this problem. Currently, macrogubres such as phosphorus, potassium and many microgubres are imported to the Republic from foreign countries, and a large amount of currency is spent on this.

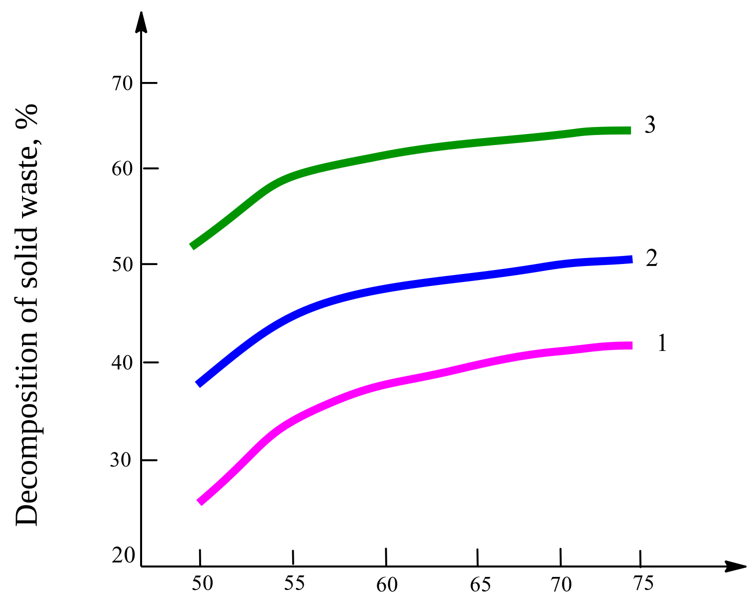
The purchase of organic-mineral fertilizers based on the decomposition of solid waste proposed by us can drastically reduce this dependence on foreign countries. As can be seen from the composition of the newly obtained fertilizer, it not only ensures the normal development of plants, but also prevents the salinization process in the soil and increases its fertility. It is economically very profitable, since it is mainly produced on the basis of waste.

Analyze and discuss

At the first stage of scientific research on obtaining organic-mineral fertilizers and ameliorative substances, the basics of Physico-Chemical bases of decomposition of solid waste with sulfuric acid solution were studied.

At this stage, the dynamics of the decomposition of the SHW acid solution depending on its viscosity and the kinetics of the decomposition process were studied. During the studies, the concentration of sulfuric acid solution was taken at the limits of 10; 15 and 20%, and in accordance with these concentrations, the amount of SHW decomposition was determined. As can be seen from Figure 1, the maximum amount of decomposition of solid household waste was achieved by applying a 20% sulfuric acid solution. Thus, with the introduction of 10% sulfuric

acid, only 35-36% of solid waste was decomposed. As a result of increasing the concentration of the solution to 15%, it was possible to increase the amount of decomposition in percentage terms to 50-52%. The best indicator was obtained with 20% sulfuric acid solution. At the same time, about 65% of solid waste was broken down.
In the second stage of the study, the kinetics of the decomposition process with the participation of SHW sulfuric acid was investigated. During the experiments carried out in this direction, the initial temperature of the acid solution, its norm, mixing intensity and mixing time were adopted in different limits.



The norm of sulfuric acid is 70 m.f. 100 according to the SHW

Figure 1: Dependence of the decomposition ability of sulfuric acid in the decomposition of solid household waste on its viscosity.

1– 10% of H_2SO_4, 2 –15% of H_2SO_4, 3 – 20 % of H_2SO_4.

As can be seen from the analysis data, the decomposition of SHW varies within a fairly large interval depending on the change in the concentration of sulfuric acid. This can be seen as a good case from the point of view of solid waste disposal. However, when the concentration of sulfuric acid solution varies between 5-10%, the moisture content in the obtained mass becomes much higher. The high moisture content can be regarded as a positive result, so that the natural mineral compounds added to this mixture do not need additional acid to break down (Table 1, Figure 2).

Table 1: Kinetics of the decomposition process of solid waste depending on the concentration of sulfuric acid . (Acid starting temperature 40^{0}C, norm 70 m.f., 100 m.f. solid household waste; mixer intensity 120 period/min)

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H_2SO_4 concen-tration, %	Time, minutes								
	4	6	8	10	12	14	16	18	20
5	6	9	11	13	15	18	24	26	31
10	9	11	13	14	16	19	25	28	33
20	12	15	17	20	21	23	32	34	38
30	16	24	27	29	29	31	36	41	44
40	20	27	31	34	34	36	38	44	49
50	23	30	35	37	39	40	44	48	53
60	27	33	38	40	43	45	47	52	54
70	24	29	33	37	39	42	44	49	54

When the SHW analyzes the amount of decomposition depending on the initial temperature, it is clear that increasing the temperature above 60^0C does not have as much effect on the amount of decomposition in percentage terms. On the other hand, we recommend that the temperature of the process be kept within $60\text{-}65^0$C, as it is not economically viable to increase the temperature. Thus, the amount of SHW decomposition in 65^0C varies between 44-56% depending on the concentration of the solution, which can be considered a very good indicator (Table 2, Figure 3).
In addition, it is not recommended to increase the temperature in terms of corrosion of the apparatus and evaporation of acid, polluting the environment. Thus, in the process of decomposition of solid household waste, it is necessary to accept the optimal value of the starting temperature of 60^0C.

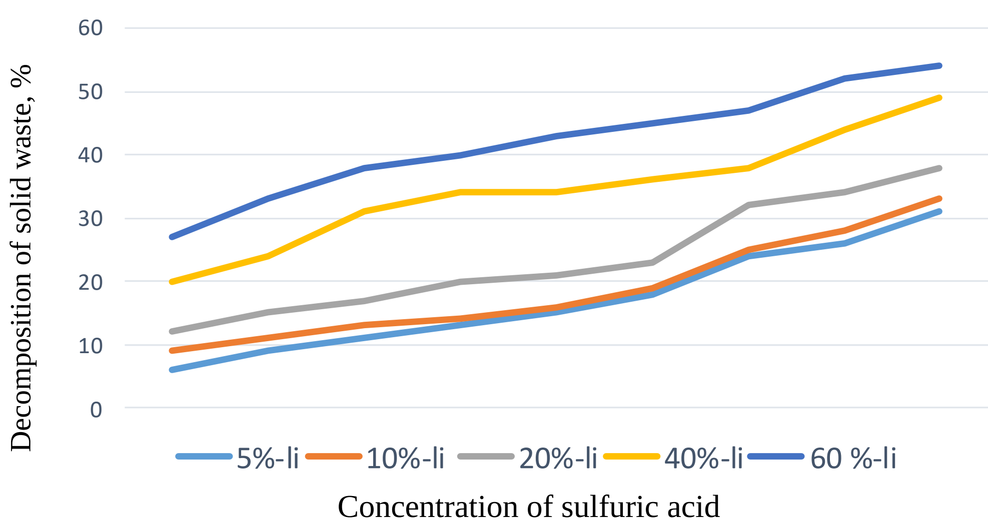


Figure 2: Dependence of the decomposition ability of sulfuric acid in the decomposition of solid household waste on its viscosity.

Table 2: Decomposition of solid household waste depending on the concentration of the solution in different norms of sulfuric acid (Starting temperature of solution of sulfuric acid 40^{0}C, norm 70 m.f., 100 m.f. SHW; mixing intensity 120 peroid/min, mixing intensity 30 min.)

H_2SO_4 concen-tration, %	Time, minutes						
	36	60	64	68	72	76	80
5	12	14	18	24	30	36	44
10	16	24	26	36	44	48	55
20	23	33	41	47	51	53	60
30	25	35	42	51	55	57	65
40	31	41	46	54	60	64	68
50	34	46	52	60	66	68	72
60	39	49	56	65	73	75	78
70	43	54	57	66	74	76	78

The mixing intensity of the mixer is of great importance during the experiment, which is usually carried out with acid solutions.

Taking into account that it is known that mixing is the main factor in the processes of dissolution and crystallization, it has been studied simultaneously with the influence of the concentration of sulfuric acid solution on the decomposition of waste at different values of the mixing intensity during the decomposition of SHW sulfuric acid.

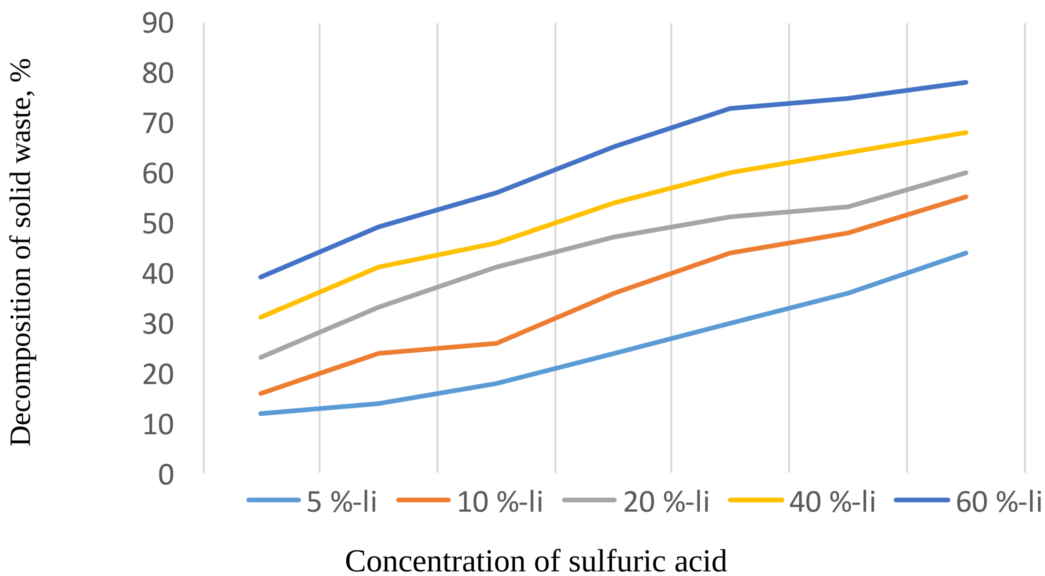


Figure 3: Dependence of the decomposition capacity of sulfuric acid on its viscosity in the decomposition of solid household waste.

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The intensity of the mixer during the experiment is 40-180 per/min., which was between 5 and 70% by the consistency of the solution. The results obtained from the experiment are presented in Table 3.
40; 80; 120; 140; 160 and 180 per/min. of the mixing intensity at the indicated concentrations of the acid solution. The SHW decomposition ranged between 15-82% (Figure 4).
Analysis of the obtained data allows us to adjust the mixing intensity of 40-140 per/min. accept between. The SHW decomposition from such mixing intensity varies between 15-73% in different solids.
As a result of the research and analysis of the results obtained from the experience of studying the concentration of the acid solution, the mixing time and the effect of decomposition of solid waste in the presence of sulfuric acid, the following conclusions were reached:

Table 3: Decomposition of solid waste at different mixing intensities, depending on the concentration of sulfuric acid. (Norm of sulfuric acid 70 m.f., SHW 100 m.f., starting temperature 40^0C)

H_2SO_4 concen-tration, %	Time, minutes					
	40	80	120	140	160	180
5	15	16	26	32	38	42
10	18	26	30	36	42	48
20	27	33	37	41	48	53
30	31	37	41	45	53	58
40	43	45	48	51	58	62
50	48	52	60	64	66	71
60	55	59	67	71	74	77
70	57	61	70	73	77	82

The result

1. From the point of view of the richness of macro-and microelements contained in it, the SHW is a fully usable raw material for fertilizer production.
2. It is advisable to use 10-20% sulfuric acid solution to extract food-repellent elements from the SHW. At this time, it is neutralized in harmful microorganisms contained in it.
3. Optimal temperature of technological process for transfer of nutrient elements to solution 40-60^0C, the concentration of the acid solution is 10-20%, mixing intensity is 60-140 per/min.
4. In order to improve the quality of the composition of the obtained liquid fertilizer, it is recommended to enrich the obtained fertilizer with substances containing nutritive elements at the end of the process.

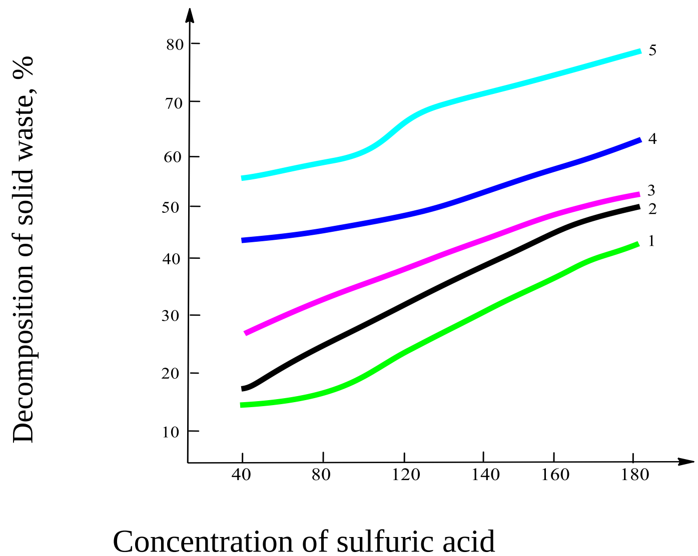


Figure 4: Dependence of the decomposition ability of sulfuric acid in the decomposition of solid household waste on its viscosity.
1– 5% of H_2SO_4, 2 –10% of H_2SO_4, 3 – 20 % of H_2SO_4, 4-40 % of H_2SO_4, 5-60 % of H_2SO_4.

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KÜKÜRD TURŞUSU MÜHİTİNDƏ BƏKR MƏŞƏT TULLANTILARININ PARÇILANMA DİNAMİKASI

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XÜLASƏ

Məqalə bərk məişət tullantısı (BMT) əsasında üzvi-mineral gübrə və kimyəvi meliorantların alınması texnologiyasının işlənilməsinə həsr olunmuşdur. Təqdim olunan məqalədə əsas etibarilə tədqiqatın ilk mərhələsi olan bərk məişət tullantısının sulfat turşusunun müxtəlif faizli məhlulları ilə parçalanmasının fiziki-kimyəvi əsasları şərh olunmuşdur. Tədqiqatın məqsədi üzvi-mineral gübrə və meliorativ maddələrin alınması texnologiyasının işlənilməsi zamanı bərk məişət tullantılarının sulfat turşusu məhlulunun qatılığından, onun başlanğıc temperaturundan, zamandan və qarışdırılma intensivliyindən asılı olaraq parçalanmasının fiziki-kimyəvi əsaslarının tədqiqidir.
Tədqiqat zamanı sulfat turşusu məhlulunun qatılığını 5%-dən 70 %-ə qədər nümunələrin parçalanma dinamikası 36-80 dəqiqə ərzində, 40 dövr/dəqiqədən 180 dövr/dəqiqə intensivliyində qarışdırma şəraitində tədqiq olunmuşdur. Hər bir amilin bərk məişət tullantısının parçalanma faizinə böyük təsiri olduğu müəyyən edilmiş, bu səbəbdən hər bir amil üzrə optimal parametrlər eksperimental təcrübələr nəticəsində müəyyən olunmuş və dəqiqləşdirilmişdir.
Aparılan tədqiqatların yekunu olaraq, tərkibində olan makro və mikroelementlərin zənginliyi nöqteyi nəzərindən bərk məişət tullantısının gübrə istehsalı üçün tam yararlı xammal olması müəyyənləşdirilmiş, bərk məişət tullantısının tərkibindən qidaverici elementlərin ekstraksiya olunmasının 10-20 %-li sulfat turşusu məhlulu ilə həyata keçirilməsinin məqsədə uyğun olması və bu zaman parçalanma ilə yanaşı onun tərkibindəki mikroorqanizmlərin zərərsizləşdirilməsi prosesinin getdiyi müşahidə olunmuşdur. Bundan elavə qidaverici elementlərin məhlula keçməsi üçün texnoloji prosesin optimal temperaturunun 40-60^{0}C, turşu məhlulunun qatılığının 10-20% arasında qarışdırma intensivliyinin 60-140 dövr/dəq olması sübuta yetirilmişdir, sonda alınmış maye gübrənin tərkibinin keyfiyyətinin yaxşılaşdırılması üçün texnoloji proses başa çatdıqdan sonra alınmış gübrənin tərkibinin qidaverici maddələrlə zənginləşdirilməsi tövsiyə olunur.

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Aparılmış tədqiqatlar nəticəsində müəyyən olunmuşdur ki, zəif turşu məhlullarının iştirakı ilə bərk məişət tullantısının parçalanması zamanı tərkibində olan qidaverici elementlərin təxminən 80-85 %-ni çıxararaq gübrə istehsalında istifadə etmək olar.
Açar sözlər: gübrə, bərk tullantılar, sulfat turşusu, meliorant, şoranlaşma, şoranlaşma.

ДИНАМИКА РАЗЛОЖЕНИЯ ТВЕРДЫХ БЫТОВЫХ ОТХОДОВ В ПРИСУТСТВИИ СЕРНОЙ КИСЛОТЫ

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РЕЗЮМЕ

Статья посвящена разработке технологии получения органо-минеральных удобрений и химических мелиорантов на основе твердых бытовых отходов (ТБО). В представленной статье изложены физико-химические основы разложения твердых бытовых отходов с различными процентными растворами серной кислоты, что в основном является первым этапом исследования. Целью исследования является изучение физико-химических основ разложения ТБО при разработке технологии получения органо-минеральных удобрений и мелиоративных средств в зависимости от густоты раствора серной кислоты, его начальной температуры, времени и интенсивности перемешивания.
В ходе исследования изучалась динамика разложения образцов при концентрации раствора серной кислоты от 5% до 70% в течение 36-80 мин, при интенсивности перемешивания от 40 об/мин до 180 об/мин. Установлено, что каждый фактор оказывает большое влияние на процент разложения ТБО, поэтому оптимальные параметры по каждому фактору были определены и уточнены в результате экспериментальных экспериментов.
По итогам проведенных исследований установлено, что с точки зрения богатства содержащихся в нем макро-и микроэлементов твердые бытовые отходы являются полностью пригодным сырьем для производства удобрений, было замечено, что экстракция питательных элементов из состава ТБО целесообразно осуществлять 10-20 %-ным раствором серной кислоты, при этом наряду с разложением идет процесс нейтрализации содержащихся в нем микроорганизмов. Кроме того, доказано, что оптимальная температура технологического процесса перехода питательных элементов в раствор составляет 40-60^{0}С, интенсивность перемешивания в пределах 10-20% твердости раствора кислоты-60-140 циклов/мин, в конце для улучшения качества состава полученного жидкого

удобрения после завершения технологического процесса рекомендуется обогащение состава полученного удобрения питxsad üürürfüfrательными веществами.
В результате проведенных исследований установлено, что при разложении твердых бытовых отходов в присутствии слабокислых растворов их можно использовать в производстве удобрений, удаляя около 80-85% содержащихся в них питательных элементов.
Ключевые слова: удобрение, твердые отходы, серная кислота, мелиорант, засоление, засоление.

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STUDY OF GAS-LIFT VALVE OPERATION

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ABSTRACT

Gas lifts are versatile, dependable lifting systems that provide numerous options. This article discusses typical problems with gas lift valves used in geotechnical applications. What could result in such operational and well-related flaws. A closed system powered by high pressure gas is a gas lift system. Gas lifts are frequently adaptable, dependable lift systems with a variety of manufacturing options. For all operations, adding gas from an outside source lowers the fluid pressure level, which forces more fluid to be kept in conditions with high water retention. Excellent product quality, changeable gas lift complex, and lift depth. Where possible, involuntary injection gas tensions and volumes are extremely rare and can support various synthetic buoyancy types. By lowering the fluid's pressure stages with the use of an extraterrestrial gas penthouse, more fluid may be stored in the Force as the descent goes on. As you alter the parameters, consider how other elements alter. The behavior of gas lift valves is predicted using a variety of techniques. These techniques additionally consider additional factors. The Thornhill-Craver equation is the formula most frequently used to forecast the performance of throttle valves. The interpretation of gas lift taps is overestimated by the Thornhill-Craver equation, particularly for big ports, according to Gerberding and Acuna. Gas lifts are not appropriate for combined liquids, supersaturated Neptune, or thick, abrasive paintings. , which focuses on how to increase the performance of weak gas lift taps, highlighting the necessity of their complicated design, does not function well for grabbing old wells or extending inflow lines with external internal compasses.
Keywords: Gas liquid Ratio (GLR), Fluid, Pressure, Gas Lift Valves (GLVs), Injection Gas, Bottom Hole Pressures (BHPs)., Continuous Flow, Intermittent Flow.

Introduction

The reservoir's energy will eventually run out, making it impossible to continue raising formation water to the surface. Because not every oil well has enough low-hole pressure (BOP) to lift fluids to the surface, some oil wells do not naturally begin producing fluids right away after startup. Using a lighter fluid as a carrier fluid to stimulate the formation fluid is one method of assisting the well's flow. In this scenario, the total density of the liquid will drop, increasing the reservoir's lifting capability.

The artificial lift method that most nearly mirrors the natural flow process is gas lift. This can be viewed as extending the process of natural flow. In an inherently attractive flow, the tension in the liquid cue is lessened as the liquid goes overhead toward the face, causing the gas to expand and move quickly overhead. The transmission of nearly uncontaminated liquids to the face is supported by a conforming gas. If this rush isn't strong enough, though, liquid might fall through joints close to the surface. To lift water, this device is frequently employed. To lower

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the liquid's degree of tension, high pressure gas is injected into the liquid throughout this process. In other words, the viscosity of the liquid is decreased by introducing additional gas to raise the gas-liquid ratio. This procedure is seen as extending the stage of natural movement. A schematic of a typical gas lift system is shown in Figure 1. It is universal, more precise than other produced lifting techniques, and efficient for a variety of liquid materials.

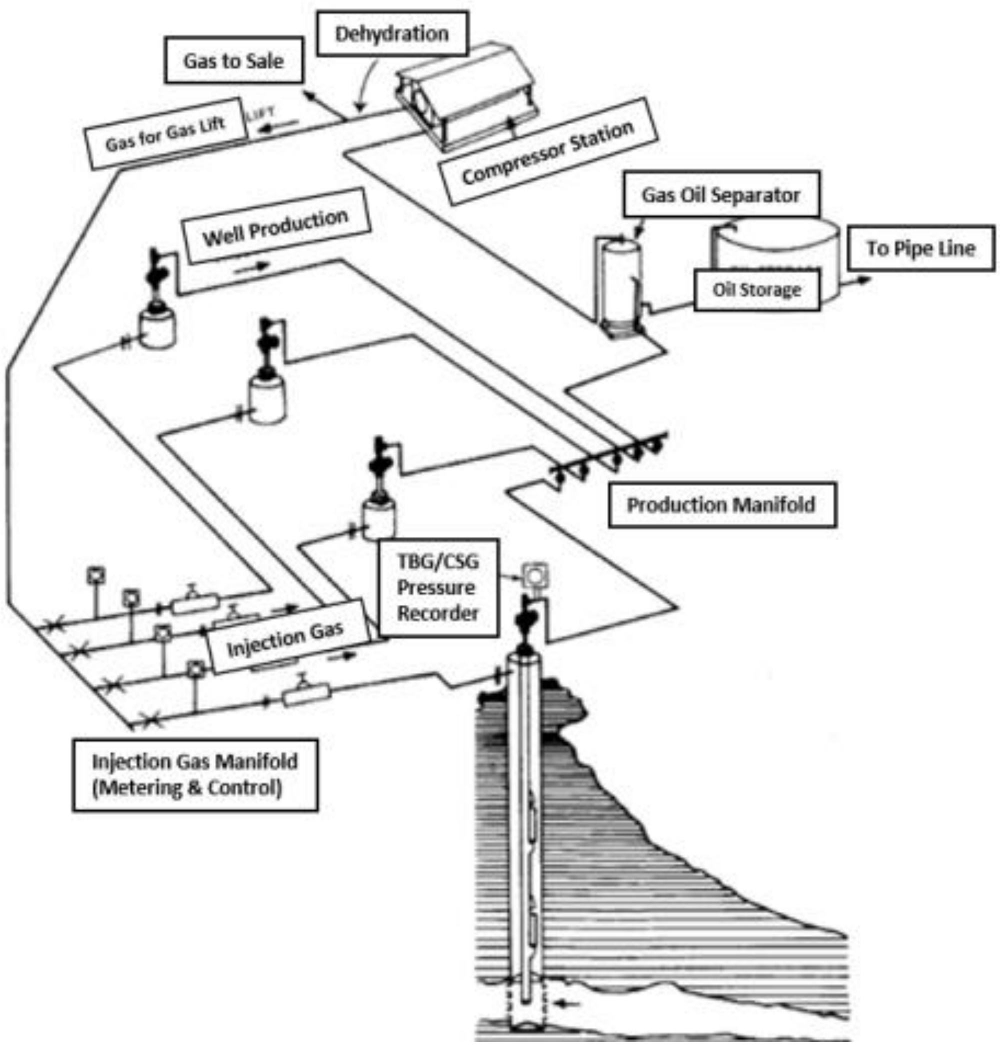


Figure 1: Typical Gas Lift System.

Let is see how many types there are. There are two different kinds of gas lift techniques: intermittent inflow and continuous inflow. In order to remove structural fluids, these gas lift techniques condition high pressure raw gas from a surface. Periodic gas inflow is a multiple-standard gas lifting technique of diligence and is actually comparable to raw inflow. At the tallest cliff, count the rate and get caught in the product pipe. As a result, the base pressure is decreased along with the liquid-liquid viscosity and liquid pressure of the combined liquid. The efficiency arrow becomes better as the well pressure drops.

Objective

The liquid is lifted to the surface by injecting enough gas pressure into the tube at the connection at the bottom of the liquid column to complete the intermittent gas lift procedure. By pumping high pressure gas into the well, intermittent flow is the incredibly unusual reverse flow of fluid through the casing. Numerous inferences can be made from this. The primary distinction between constant and irregular flow is clear. A basic criterion for high pressure gas is irregular incoming gas lift because it has an advantage over continuous incoming gas lift. This technique cannot create big amounts in other scripts compared to continuously flowing gas lifts since gas is delivered intermittently over time.

High pressure gas bases, altitude commands, clandestine operations, divergence, feeder pipes, storage apparatus, QMNs, and compressors are all used in gas lift technology. The efficient movement of each of these components is crucial to the gas lift system's effectiveness. To make sure you always have the appropriate amount of gas charged, do a hands-on procedure. The wall package must be used for gas intake. Gas lift faucets are a component of cutting-edge well gas injection techniques. The Bright Gas Lift Tap has evolved over time due to its significance.

Advantages of Gas Lift

Given that the pressure and amount of the injected gas required is open, gas lifting techniques are flexible in terms of product rate and lifting depth range, and they are rarely paired with other unnatural lifting types. It is one of the most adaptable lifting types thanks to design optimization for a fluid lift. When an industrially produced lift is sought, his GLV sand products and wells are effective advocates for gas lifts due to their great dispersion and high quality.

Gas Lift Limitations

The use of lift gas may be constrained by greater drilling distances on land and fewer available places for compressor platforms offshore. Due to the difficulty in locating a central power source, gas lifts are rarely used for single well installations and are not appropriate for long distance wells. For viscous crudes, supersaturated brines, or emulsified liquids, gaslift is not an option. Additionally, outdated containment wells and lengthy flow lines with narrow inner diameters do not accommodate gas lift systems well (IDs). Gas lifting procedures, according to Fleshmanand Lekic and Osuji, are restricted by fluid characteristics such ACP, scaling, the presence of paraffins, and corrosion.

Testing and Modeling

The behavior of gas valves is predicted using a variety of techniques. The most popular equation for forecasting restriction valve performance is the Thornhill-Craver restriction equation. Utilizing data on positive throughput adjustments, this method was created. The gas valve is regarded as an orifice when calculating gas flow using the Thornhill-Craver equation. Other studies determined the gas flow rate by treating the gas valve as a convergent-divergent nozzle. The Thornhill-Craver equation, according to Neiberding and Acuna, overstates the effectiveness of gas lift valves, particularly at large apertures.

For the purpose of analyzing the behavior of gusseted gas valves, Decker has developed a model. He used these two parameters to solve the solution for the force balance after researching the effects of thermodynamic and mechanical factors on pressure distribution.
The effects of gas compression on gas valves were not taken into account in the Thornhill-Craver equation. Additionally, the valve is not taken into account in this formula as a variable orifice. Winkler and Camp looked at how altering the flow field affected things. In order to account for gases' changing surface areas and compressibility, they updated the Thornhill-Craver equation (1).

$$Q_{gas}=\frac{155.5\times C_d\times A_e\times P_1\sqrt{2g\times\frac{K}{K-1}\times\{r^{\frac{2}{K}}-r^{\frac{K+1}{K}}\}}}{\sqrt{ZGT}} \quad (1)$$

Q_{gas}= flow rate of gas ; Mscf/D

C_d= discharge factor

A_e= Effective reception area for offices., sq inches

P_1= upflow pressure, psi

P_2= downflow pressure, psi

g= gravity accelerating, of 32.2 feet per square second.

K = Cp/Cv specific temperature ratio

$r = P_1/P_2$>ro

$ro = (2/K+1)^{k/(K-1)}$

Z= cause for compromise.

G = concentration of the gas (air=1)

T= outlet temperature, R

By taking into account the bellows load factor and the impact of actuation force on the linear motion of the stem, Winkler and Camp investigated the effectiveness of several valves. They discovered that the impact of these elements resulted in fuzzy basic mathematical models for predicting gas lift valves. In order to acquire the valve relief coefficient (Cd), which can be used to determine the precise gas lift valve flow rate, we have also added a reference valve.
Research into gas lift devices has started at the University of Tulsa's Artificial Lift Program (TUSLP). To calculate gas flow through a gas valve, an orifice and gas flow model was created. Figure 2 illustrates the flow performances that researchers developed for orifices, channels, and flow controllers.

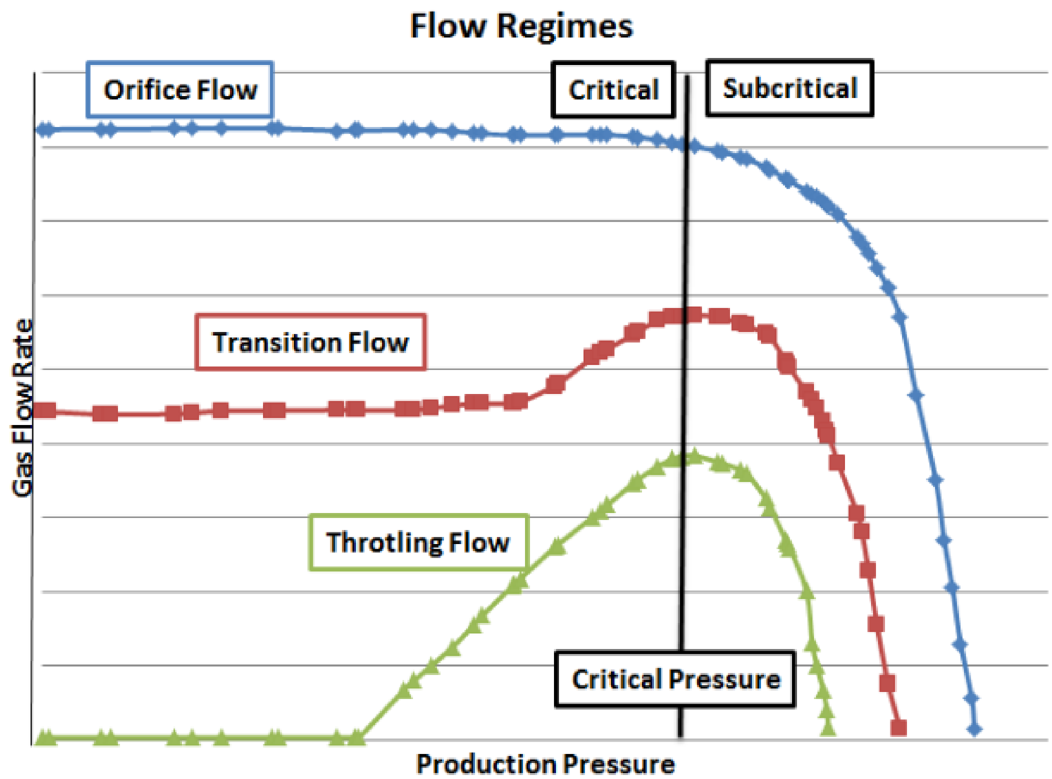


Figure 2: Different flow modes.

Bigilabigi has created a range of valve testing tools and methods. Test with continuous flow rate in a steady state (DETT). In order to simulate the nitrogen valve, spring his valve flow performance, and forecast the valve performance, he created a statistical model based on the testing results. All test results have been invalidated due to a bug in the static test bench. Nieberding fixed mistakes on the static test bench and, using test data, created a statistical model of his flow adjustments and orifices. He distinguished between the accelerator and the opening ratio using the opening pressure of his rack. He discovered that the valve would behave like a hole if the pressure in the injector was greater than the pressure in the rack's aperture. However, the valve behaves as a throttle valve if the injection pressure is higher than the valve's closing pressure and lower than the test rig's beginning pressure. In order to test the test technique, methane was also employed as the injecting gas rather than air. He also established a correlation to predict gas transformations.

$$Q_{gas} = 1240.3 \times A_p \times C_d \times Y \times A_f \sqrt{\frac{P_{iod} \times (P_{iod} - P_{pd})}{T_v \times Z_v \times S_g}} \quad (1)$$

Q_{gas}= flow rate of gas.Mscf/D

C_d= discharge factor

A_p= Port region., in^2

P_{iod}= pressure used to inject gas upstream, psig

P_{pd}= pressure used to inject gas downstream, psig

$A_f = A_{eff}/A_P$

Y= factor for gas expansion

S_g= specific gravity of gas.

Z= cause for compromise.

G = concentration of the gas (air=1)

T= outlet temperature.,

The Result

1. Gas lifts are often adaptable artificial buoyancy devices that are trustworthy and able to handle a variety of production possibilities. Numerous factors, including variations in the type of fluids produced, wellbore productivity index, and wellbore and bottom pressure, might affect the design of a gas lift system. The gas injection pressure will alter as these parameters do.
2. Surface compression and valve installation are needed for gas lift systems to lift downhole gas. Gas lift systems are typically a gentle approach to increase productivity. In other words, even shoddy gas lifts can function better. Gaslift can increase fluid performance, but doing so necessitates a more intricate design for each component of the system.

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ИССЛЕДОВАНИЕ РАБОТЫ ГАЗЛИФТНОГО КЛАПАНА

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РЕЗЮМЕ

Газлифт — это гибкая и надежная подъемная система, которая может предоставить широкий спектр возможностей. В статье рассмотрены общие недостатки газлифтного клапана, предназначенного для использования в геолого-технических мероприятиях. Чем могут быть вызваны такие недостатки в скважинах или в процессе эксплуатации. Газлифтные системы представляют собой закрытые системы, работающие на газе под высоким давлением. Как правило, газовый лифт представляет собой гибкую и надежную подъемную систему, которая может использовать широкий спектр производственных возможностей. Во всем процессе используется подача газа из внешнего источника для снижения градиента давления жидкости для работы, чтобы можно было удерживать больше жидкости из пласта при более высоких уровнях удержания воды. С точки зрения диапазонов производительности и глубины подъема газлифтная система является гибкой и редко может быть согласована с другими методами механизированной добычи, когда доступны необходимое давление и объем закачиваемого газа. Весь процесс использует подачу газа из внешнего источника для снижения градиента давления флюида, чтобы больше флюида могло храниться в пласте с более высокой депрессией.Рассматривается, как изменяются другие факторы при изменении параметров. Для прогнозирования поведения газлифтного клапана используются различные методы. В этих методах учитываются и другие параметры. Уравнение Торнхилла-Кревера является наиболее часто используемым уравнением для прогнозирования работы дроссельной заслонки. Нейбердинг и Акуна показали, что уравнение Торнхилла-Кревера завышает производительность газлифтных клапанов, особенно для портов большего размера. Газлифт не подходит для вязкой сырой нефти, пересыщенного рассола или эмульсионной жидкости. Кроме того, газлифтная система не подходит для старых удерживающих скважин или длинных выкидных линий с малым внутренним диаметром. В целом, как газлифтная система является методом повышения производительности, или другими словами, как улучшить работу слабых газлифтных клапанов, а кроме того, подчеркивается важность ее сложной конструкции.

Ключевые слова: Газлифтные клапаны (ГК); Забойные давления(ЭД); Соотношение газа и жидкости (СГЖ); непрерывный поток; прерывистый поток; Жидкость; Давление; Инжекторный газ

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QAZ-LİFT KLAPANININ İŞİNİN TƏDQİQİ

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XÜLASƏ

Qaz lifti geniş imkanlarını təmin edə bilən çevik və etibarlı şəkildə qaldırma sistemidir. Məqalədə geoloji – texniki fəaliyyətlərdə istifadə üçün nəzərdə tutulmuş qazlift klapanının ümumi çatışmazlıqlara baxılır. Bu kimi çatışmazlıqları quyularda və ya istismar prosesində nələr yarada bilər. Qaz lift sistemləri yüksək təzyiqli qazla işləyən qapalı bir sistemdir. Bir qayda olaraq qaz lifti geniş istehsal imkanlarını istifadə edə bilən çevik və etibarlı qaldırma sistemidir. Bütün proses xarici mənbədən qaz əlavə olaraq işləmək üçün maye təzyiqinin qradiyentini azaltmaq üçün istifadə olunur ki, daha yüksək səviyyədə su tutma zamanı laydan daha çox maye saxlanılsın. İstehsal sürəti diapazonları və qaldırma dərinliyi baxımından qazlift sistemi çevikdir və lazımi enjeksiyon qazı, təzyiqi və həcmi mövcud olduqda nadir hallarda digər süni qaldırma üsulları ilə uyğunlaşdırıla bilər. Bütün proses, xarici mənbədən qaz əlavə olaraq maye təzyiq qradiyentini azaltmaq üçün istifadə olunur ki, daha yüksək bir enmə ilə rezervuardan daha çox maye saxlanılsın. Bundan əlavə parametrlər dəyişdirilən zaman digər amillər necə dəyişilir onlara baxılır. Qaz lift klapanın davranışını proqnozlaşdırmaq üçün müxtəlif üsullardan istifadə olunur. Bu üsullar vaxtı digər parametrlərədə baxılır. Thornhill-Craver tənliyi qaz klapanının performansını proqnozlaşdırmaq üçün ən çox istifadə edilən tənlikdir. Neiberdinq və Acuna təqdim etdi ki, Thornhill-Craver tənliyi qaz lift klapanların performansını, xüsusən daha böyük port ölçüləri üçün həddindən artıq nəticəni qiymətləndirir. Qaz lifti özlü xam neft, həddindən artıq doymuş duzlu su və ya emulsiya mayesi üçün yaxşı deyil. Bundan əlavə, qazlift sistemi köhnə tutma quyuları və ya kiçik daxili diametrli uzun axın xətləri üçün yaxşı işləmir. Ümumiyyətlə, qaz lift sistemi məhsuldarlığı artırmaq üçün necə bir üsuldur, və ya başqa sözlə, zəif qaz lift klapanlarının performansı necə artırılır və əlavə olaraq onun mürəkkəb dizaynının önəmi vurğulanır.

Açar sözlər: Qaz lift Klapanı (QLK); Alt Çuxur Təzyiqlər (AÇT); qaz-maye nisbəti (QMN); Davamlı axın; Fasiləli axın; maye; təzyiq; Enjeksiyon qazı.

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DATA CLEANING BEFORE UPLOADING TO STORAGE

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ABSTRACT

The article considered the issue of cleaning big data before uploading it to storage. At this time, the errors made and the methods of eliminating these errors have been clarified.
The technology of creating a big data storage and analysis system is reviewed, as well as solutions for the implementation of the first stages of the Data Science process: data acquisition, cleaning and loading are described. The results of the research allow us to move towards the realization of future steps in the field of big data processing.
It was noted that Data cleansing is an essential step in working with big data, as any analysis based on inaccurate data can lead to erroneous results.
Also, it was noted that cleaning and consolidation of data can also be performed when the data is loaded into a distributed file system.
The methods of uploading data to the storage system have been tested. An assembly from Hortonworks was used as the implementation. The easiest way to upload is to use the web interface of the Ambari system or to use HDFS commands to upload to HDFS Hadoop from the local system.
It has been shown that the ETL process should be considered more broadly than just importing data from receivers, minimal transformations and loading procedures into the warehouse. Data cleaning should become a mandatory stage of work, because the cost of storage is determined not only by the amount of data, but also by the quality of the information collected.
Keywords: Big Data, Data Cleaning, Storage System, ETL process, Loading methods.

Real data is often messy - contains various kinds of errors - and unstructured, so it must be processed before use. The data may contain errors, have duplicate entries, be in the wrong format, or be inconsistent. The process of solving these types of problems is called data cleansing. Data cleaning is also called processing, kneading, reshaping or data processing. Data merging, in which data from multiple sources is combined, is often considered data cleansing.
Data cleansing is an essential step in working with big data, as any analysis based on inaccurate data can lead to erroneous results. Thus, it is necessary to make sure that the data we work with is qualitative data. Data quality includes: [1,p.78]

- *Validity:* the requirement to ensure the correct form or structure of data;
- *Accuracy:* the values in the data are truly representative of the data set;
- *Completeness*: no missing elements;
- *Consistency*: changes in the data are synchronized;
- *Uniformity:* the same units of measure are used.

It should be noted that cleaning and consolidation of data can also be performed when the data is loaded into a distributed file system.

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When creating data warehouses, insufficient attention is still paid to cleaning the information that enters it. Apparently, it is believed that the larger the storage size, the better. This is a surefire way to turn a data warehouse into a garbage dump.

The data needs to be cleared. After all, information is heterogeneous and almost always collected from many sources. It is the presence of various data collection points that makes the cleaning process so complex and relevant.

Mistakes are always made, and it is impossible to completely get rid of them. Perhaps sometimes it makes sense to put up with them, rather than spend resources on fixes. But, in general, you need to strive by any means to reduce the number of errors to an acceptable level. The methods used for analysis already sin with inaccuracies, so why aggravate the situation?

In addition, it is necessary to take into account the psychological aspect of the problem. If the analyst or decision maker is unsure of the numbers he is getting from the data warehouse, he will rely on information from other sources. This seriously reduces the value of the storage.

Error types

We will not cover simple errors such as type mismatches, differences in input formats and encodings. Cases where information comes from several sources, where different conventions are adopted to denote the same fact.

A typical example of such a mistake is the designation of a person's gender. Somewhere it is designated as *M/F,* somewhere as *1/0,* somewhere as *True/False*. These kinds of errors are dealt with by specifying rules for recoding and type casting, so they are relatively easy to solve. We are interested in more complex problems that cannot be solved by elementary methods.

There are many types of complex errors. In addition to universal ones, there are errors that are specific only to a particular subject area or task. But let's consider those that do not depend on the task: [1,p.82]

- Inconsistency of information (Contradiction);
- Gaps in data;
- Abnormal values;
- Noise;
- Data entry errors.

To solve each of these problems, there are proven methods. Of course, errors can be corrected manually, but with large amounts of data, this becomes problematic. Therefore, we will consider options for solving these problems in automatic mode with minimal human participation.

Inconsistency of information (Contradiction)

First we need to decide what exactly is considered a contradiction. Oddly enough, this is not a trivial task. For example, a pension card in different countries must be changed if the last name, first name, patronymic and gender change. It turns out that there is no contradiction in the fact that a person was born a woman and retired a man.

After we decide what to consider a contradiction, and find such entries, there are several options for action:

If several conflicting entries are found, delete them all, or leave one of the options selected according to some simple rule. For example, the most recent entry. The method is trivial, and therefore easy to implement. Sometimes this is enough. [3,p.112]

Correct inconsistent data based on statistics. For example, you can calculate the probability of occurrence of each of the inconsistent values and choose the most likely one. Most often, this method gives more correct results.

Gaps in the data

This problem is the scourge of many data stores. Most forecasting methods are based on the assumption that the data comes in a uniform constant stream. In practice, this rarely happens. Therefore, one of the most popular areas of application of data warehouses - forecasting - is implemented poorly or with significant limitations. To combat this phenomenon, you can use the following methods:

Approximation

If there is no data at any point, we take its neighborhood and calculate the value at this point using known formulas, adding the corresponding record to the storage. This works well for ordered data. For example, information about daily product sales. [3,p.115]

Determination of the most plausible value

For this, not the neighborhood of the point is taken, but all the data. This method is used for unordered information, i.e. cases when we are not able to determine what is the neighborhood of the point under study.

Abnormal values

Quite often, events occur or data come across that are very out of the picture. For example, the price of a product is 10 times higher than the average. It is best to correct such values. The fact is that the analysis algorithms know nothing about the nature of the processes. Therefore, any anomaly will be perceived as a completely normal value. Because of this, the model is greatly distorted, because random failure or success will be considered a pattern.

There is a method of dealing with this problem - robust estimates. These methods are resistant to strong perturbations. An example would be a median filter. [5,p.127]

We evaluate the available data, and for anything that is out of range, we apply one of the following actions:

Abnormal values are removed;

Anomalous data are replaced by the nearest boundary values.

Noise

Almost always in the analysis we encounter noise. Most often, the noise does not carry useful information, but only makes it difficult to clearly see the picture. There are several ways to deal with this phenomenon:

Spectral analysis

With it, we can cut off the high-frequency components of the data, i.e., these are frequent and slight fluctuations around the main signal. Moreover, by changing the width of the spectrum, you can choose what kind of noise we want to remove. [7,p.234]

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Autoregressive methods
This fairly common method is actively used in the analysis of time series. It comes down to finding a function that describes the process as a signal plus noise. Actually, the noise can then be removed and the main signal left.

Data entry errors
This is a topic for a separate discussion, because the number of types of such errors is too great, for example, typos, deliberate distortion of data, inconsistencies in formats, and this is not counting errors related to the peculiarities of the data entry application. [7,p.236]
To deal with most of them, there are proven methods. Some things are obvious, for example, before entering data into the repository, you can check the formats. Some are more sophisticated. For example, you can correct typographical errors based on various kinds of thesauri. But, in any case, it is necessary to clear and from such errors.

Extract, Transform and Load (ETL)

Extract, Transform and Load (ETL) is a data conveyer used to collect data from various sources. It then transforms the data according to the business rules and loads it into the target data store. The transformation process in the ETL conveyer is performed in a special subsystem. Intermediate tables are often used to temporarily store data while it is being converted and before it is loaded to the destination.

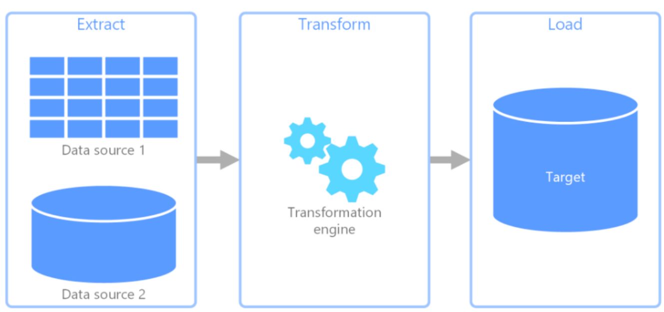


Figure 1: Extract, Transform and Load (ETL)

Typically, various operations (such as filtering, sorting, aggregating, merging, cleaning, deduplicating, and data validation) are applied in the data transformation process.
Often the three ETL steps are done in parallel to save time. For example, when extracting data, the transformation process may already be processing the received data and preparing it for loading, and the loading process may start processing the prepared data without waiting for the extraction to complete.
The Extract, Load, and Transform (ELT) conveyer differs from ETL only in the transformation execution environment. In the ETL conveyer, the transformation takes place in the target data store. In this case, instead of a special subsystem, processing facilities of the target data store are used to transform the data. This simplifies the architecture by removing the conversion engine

from the conveyer. Another benefit of this approach is that scaling the target data store also improves the performance of the ETL conveyer. However, the ELT only works properly if the target system has sufficient performance to effectively transform the data. [9,p.132]

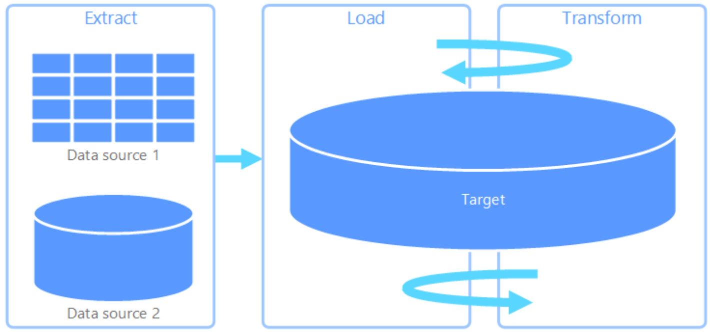


Figure 2: Extract, Transform and Load (ETL) Conveyer

Typically, the ELT conveyer is used to process large amounts of data. For example, you can extract all raw data into flat files to scale-out storage (such as Hadoop Distributed File System, Azure Blob Storage, or Azure Data Lake Store Gen2, or a combination of both). You can then use technologies such as Spark, Hive, or PolyBase to query the source data. The key feature of ELT is that the data store used to perform the transformation is the same store where the data is ultimately consumed. This data store reads data directly from scale-out storage instead of loading it into its own secure storage. This approach skips the copy step (found in ETL) which can often be time consuming when processing large datasets.
Typically, the target storage is a data warehouse using a Hadoop cluster (using Hive or Spark) or dedicated SQL pools in Azure Synapse Analytics. Most often, the schema is overlaid on flat file data at query time and stored as tables, allowing you to query the data in the same way as any other table in the data warehouse. They are called external tables because the data is not in storage managed by the data warehouse itself, but in an external, scale-out storage such as Azure Data Lake Store or Azure Blob Storage. [9,p.136]
The data store only manages the data schema and applies it when it is read. For example, a Hadoop cluster using Hive describes a Hive table where the data source is the actual path to a set of files in HDFS. In Azure Synapse, PolyBase can achieve the same result by creating a table with data stored outside of the database itself. Once the source data is loaded, the data in the external tables can be processed using the data warehouse capabilities. In big data scenarios, this means that the data warehouse must support massively parallel processing (MPP), where data is broken into smaller chunks and the processing of those chunks is distributed across multiple nodes in parallel. [9,p.136]
The last step in the ELT conveyer is usually the transformation of the original data into a final format that is more efficient for the types of queries that need to be supported. For example, the data may be partitioned. In addition, ELT can use optimized storage formats (such as Parquet) that store row data as columns and provide optimized indexing.

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Data flow and Control flow

In the context of data pipelines, the flow of control ensures that a set of tasks are processed in the correct order. For this, queuing is used. You can think of these constraints as connectors in the workflow diagram shown below. Each task has a result (success, failure, or completion). All subsequent tasks start processing data only when the previous task has completed with one of these results.

Flows of control execute data flows as a task. As part of the data flow task, data is retrieved from the source, transformed, and loaded into the data warehouse. The output of one Data Flow Task can be used as input to the next Data Flow Task, and these flows can run concurrently. Unlike control flows, you cannot add constraints between tasks in a data flow. However, you can add a data viewer to observe the data as it is processed by each task. [10,p.28]

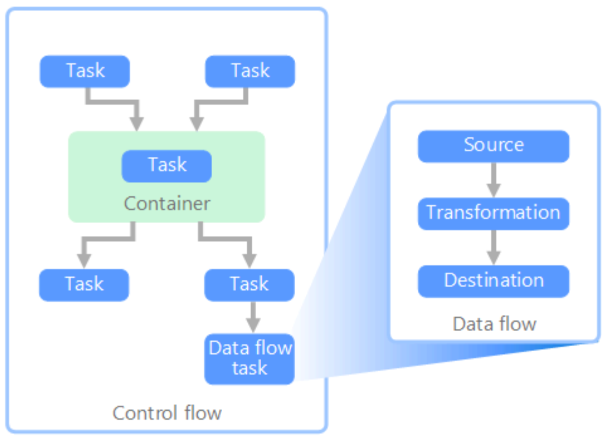


Figure 3: Data Flow And Control Flow

Loading data into a Big data storage and analysis system

Loading data into a distributed file system or a NoSQL database can also be done in various ways, for example: [6, p.113]

- using utilities such as *hdfs*, *hdfs shell;*
- using the GUI interface of the big data storage and analysis system, such as Ambari;
- using specially designed applications;
- using Yarn, Spark.

The study explored the first two ways to load data.

Loading data using the *hdfs* command is similar to working with files in a Unix class operating system. Creating a download directory in *hdfs* is done with the command: [6, p.118]

hdfs dfs - mkdir /usr/ data **(1)**

which creates the data directory inside the *usr* directory on the distributed file system.

Copying the *data.csv* file from the local host to the Hadoop distributed file system is done by the command:

hdfs dfs - put data.csv /usr/ data **(2)**

In addition, the following *hdfs* commands can be used:

ls - read the contents of a directory;
rm - delete a file;
du -h - display the file size;
cmod - change access attributes;
cat - read the contents of a file;
mv - move a file to a new location.
Uploading a file to a big data storage and analysis system using the *hdfs* utility: [6, p.120]
[maria_dev@sandbox-hdp ~]$ hdfs dfs -mkdir data
[maria_dev@sandbox-hdp ~]$ hdfs dfs -ls
Found 1 items
drwxr-xr-x - maria_dev hdfs 0 2019-06-13 06:35 data
[maria_dev@sandbox-hdp ~]$ hdfs dfs -put "/home/user/data-20181205-structure-20181205.csv" data

The second way to load data is to use the web interface of the Ambari system to build the Hortonworks big data storage and analysis system. After logging in, it is possible to navigate through HDFS and select the desired directory to upload the file.
After downloading the file, you can change the access rights to files and directories.

Data cleaning evaluation
In order to compare the influence of data filling on prediction, we eliminate different proportions of data and perform neural network on the remaining data after data filling with 3 different methods:

- Interpolation;
- Regression;
- Clustering.

We tested 3 methods in two data missing scenarios: missing at random and continuous missing. Two evaluation indices are applied: TIC of prediction and accuracy of filled data compared with real data. The results are summarized in Table 1 and Table 2.

Table 1: Evaluation of Data Cleaning (Missing at Random, TIC=6.32% when no data missing)

Missing Rate	No filling	Interpolation		Regression		Clustering	
	TIC	Accuracy	TIC	Accuracy	TIC	Accuracy	TIC
10%	7.61%	90.29%	6.79%	95.09%	7.47%	94.03%	6.92%
20%	9.91%	86.25%	7.02%	94.64%	7.56%	92.84%	7.22%
30%	12.23%	85.88%	7.24%	94.24%	7.90%	92.67%	7.56%
40%	13.09%	84.25%	7.30%	93.77%	8.43%	92.55%	7.62%
50%	16.58%	79.06%	7.76%	92.99%	8.72%	91.59%	7.97%

Table 2: Evaluation of Data Cleaning (Continuous Missing, TIC=6.32% when no data missing)

Missing Rate	No filling	Interpolation		Regression		Clustering	
	TIC	Accuracy	TIC	Accuracy	TIC	Accuracy	TIC
10%	9.11%	85.19%	7.31%	95.76%	7.31%	93.86%	7.30%
20%	11.82%	83.02%	7.44%	93.60%	7.66%	92.71%	7.44%
30%	13.73%	81.20%	9.38%	93.98%	8.51%	92.31%	7.63%
40%	16.65%	79.83%	10.36%	92.63%	9.22%	91.45%	8.31%
50%	19.93%	75.78%	12.33%	94.32%	9.63%	89.60%	8.97%

Table 3: Data Filling Evaluation (Missing at Random)

Filling Method	Average Accuracy of Data Filling	TIC Improvement after Data Filling
Interpolation	66.96%	12.28%
Regression	82.66%	23.15%
Cluster	79.77%	23.88%

In this case, if we compare the accuracy of filled data, the accuracy of regression is the highest. However, using the data filled with clustering method, the prediction is more accurate, as is summarized in Table 3. Therefore in this case, the in-sample evaluation method does not agree with the prediction result, while the latter one is the real target of big data application.

Dirty data is a very big problem. In fact, they can nullify all efforts to fill the data warehouse. At the same time, it should be borne in mind that we are not talking about a one-time cleaning, but about constant work in this direction. As the saying goes, “it’s not clean where they don’t litter, but where they clean it”. The ideal option is to implement special procedures in the ETL process to ensure that the data is cleaned before it is loaded into the warehouse.

Data changed during the cleaning process should be flagged to take this aspect into account in subsequent analysis. Otherwise, there is a risk of relying on them as real information, which can lead to incorrect outcomes.

The solutions described above are not the only ones. There are quite a few other processing methods that can help improve the quality of data, ranging from expert systems to neural networks. At the same time, it should be taken into account that cleaning methods can be strongly tied to the subject area. For example, what for some is noise for others is very valuable information.

In view of the foregoing, the ETL process should be considered more broadly, and not only as procedures for importing data from receivers, minimal transformations, and loading into storage. Data cleaning should become a mandatory stage of work, because the value of the storage is determined not only, and not so much by the amount of data, but by the quality of the information collected.

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ОЧИСТКА ДАННЫХ ПЕРЕД ЗАГРУЗКОЙ В ХРАНИЛИЩЕ

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РЕЗЮМЕ

В статье рассмотрен вопрос очистки больших данных перед их загрузкой в хранилище. На данный момент выяснены допущенные ошибки и методы устранения этих ошибок.
Рассмотрена технология создания системы хранения и анализа больших данных, а также описаны решения для реализации первых этапов процесса Data Science: сбора, очистки и загрузки данных. Результаты исследования позволяют двигаться к реализации будущих шагов в области обработки больших данных.

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Было отмечено, что очистка данных является важным этапом в работе с большими данными, так как любой анализ, основанный на неточных данных, может привести к ошибочным результатам.
Также было отмечено, что очистка и консолидация данных могут выполняться и при загрузке данных в распределенную файловую систему.
При создании хранилищ данных до сих пор недостаточно внимания уделяется очистке поступающей в него информации. Видимо, считается, что чем больше размер хранилища, тем лучше. Это верный способ превратить хранилище данных в свалку мусора.
Данные нужно очистить. Ведь информация разнородна и почти всегда собирается из множества источников. Именно наличие различных точек сбора данных делает процесс очистки таким сложным и актуальным.
Опробованы методы загрузки данных в систему хранения. В качестве реализации использовалась сборка от Hortonworks. Самый простой способ загрузки — использовать веб-интерфейс системы Ambari или использовать команды HDFS для загрузки в HDFS Hadoop из локальной системы.
Показано, что процесс ETL следует рассматривать шире, чем просто импорт данных из приемников, минимальные преобразования и процедуры загрузки в хранилище. Очистка данных должна стать обязательным этапом работы, ведь стоимость хранения определяется не только объемом данных, но и качеством собранной информации.
Ключевые слова: большие данные, данных очистки, система хранения, ETL-процесс, методы загрузки.

ANBARA YÜKLƏMƏDƏN ƏVVƏL VERİLƏNLƏRİN TƏMİZLƏNMƏSİ

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XÜLASƏ

Məqalədə böyük verilənlərin yaddaşa yükləməzdən əvvəl təmizlənməsi məsələsi nəzərdən keçirilib. Bu zaman yol verilmiş səhvlər və bu səhvlərin aradan qaldırılması üsulları aydınlaşdırılıb.
Böyük verilənlərin saxlanması və təhlili sisteminin yaradılması texnologiyası nəzərdən keçirilib, həmçinin Data Science prosesinin ilk mərhələlərinin həyata keçirilməsi üçün həllər: verilənlərin toplanması, təmizlənməsi və yüklənməsi təsvir edilib. Tədqiqatın nəticələri bizə böyük verilənlərin emalı sahəsində gələcək addımların reallaşmasına doğru irəliləməyə imkan verir.
Qeyd edilib ki, verilənlərin təmizlənməsi böyük verilənlərlə işləmək üçün vacib addımdır, çünki qeyri-dəqiq verilənlərə əsaslanan istənilən təhlil səhv nəticələrə gətirib çıxara bilər.
Həmçinin qeyd olunub ki, verilənlərin təmizlənməsi və konsolidasiyası verilənlər paylanmış fayl sisteminə yükləndikdə də həyata keçirilə bilər.

Verilən anbarları yaradılarkən ona daxil olan verilənlərin təmizlənməsinə hələ də kifayət qədər diqqət yetirilmir. Göründüyü kimi, saxlama ölçüsü nə qədər böyük olsa, bir o qədər yaxşı olduğuna inanılır. Bu, verilən anbarını zibil qutusuna çevirməyin etibarlı yoludur.
Məlumatları təmizləmək lazımdır. Axı, məlumat heterojendir və demək olar ki, həmişə bir çox mənbələrdən toplanır. Təmizləmə prosesini bu qədər mürəkkəb və aktual edən müxtəlif məlumat toplama məntəqələrinin olmasıdır.
Verilənlərin saxlama sisteminə yüklənməsi metodları sınaqdan keçirilib. Tətbiq kimi Hortonworks qovşağı istifadə edilib. Yükləmənin ən asan yolu Ambari sisteminin veb interfeysindən istifadə etmək və ya yerli sistemdən HDFS Hadoop-a yükləmək üçün HDFS əmrlərindən istifadə etməkdir.
Göstərilmişdir ki, ETL prosesi yalnız qəbuledicilərdən verilənlərin idxalı, minimal transformasiyalar və anbara yükləmə prosedurlarından daha geniş şəkildə nəzərdən keçirilməlidir.
Verilənlərin təmizlənməsi işin məcburi mərhələsinə çevrilməlidir, çünki saxlama dəyəri yalnız verilənlərin miqdarı ilə deyil, həm də toplanan verilənlərin keyfiyyəti ilə müəyyən edilir.
Açar sözlər: böyük verilənlər, verilənlərin təmizlənməsi, saxlama sistemi, ETL prosesi, yükləmə metodları.

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IMPROVING THE EFFICIENCY OF OIL PREPARATION AND REFINING PROCESSES

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ABSTRACT

The main technologies of preparation, transportation of oil and processing of various petroleum raw materials are considered from the point of view of ways of their improvement, energy saving, efficiency improvement due to the preparation of raw materials, optimization of flow heat recovery schemes, improvement of hardware design, etc.
Today, the issue of improving the environmental and economic components in the petrochemical industry is acute. In oil fields, special attention should be paid to improving the efficiency of oil treatment.
It is necessary to maximize the use of available reserves, to reduce the losses of petroleum products that may occur during the extraction, processing and transportation of oil.
Statistics show that up to 9% of the total mass of petroleum products is lost per year during delivery to the consumer, pumping of the substance and processing of crude oil.
The substance is reduced as a result of evaporation, while not only the mass is lost, but also important components of the substance, which are raw materials for petrochemical industries.
During fuel processing, losses of light hydrocarbons are observed, they occur during various kinds of discharge operations, as well as during permanent storage of oil in one position. To optimize the processes of the oil refining industry, it is necessary to ensure less loss of substance in operation.
Increasing the efficiency of the use of oil in the process of its processing is necessary, as this will allow selecting the best oil products.
Efficiency can be improved by replacing old equipment with new ones or by overhauling old installations. However, at the moment, the replacement of equipment at all enterprises is simply impossible due to the lack of working capital.
Keywords: modernization, energy carriers, heat exchange, recovery, energy efficiency, technologies, reactors, furnaces, heat exchangers

Introduction

Before being processed, oil already in the field must go through the stages of preparation – dehydration and desalination, as well as stabilization (removal of the main part of the associated gas). After that, stable oil is transported to the refinery with a minimum amount of water and salts. When processing oil at a refinery, the stage of raw material preparation plays an essential role in any technological process, which can be carried out in various ways. First of all, it is hydrotreating, precise regulation of the fractional composition, and for heavy raw materials – deasphalting, adsorption cleaning, etc. Various measures of external influence on crude oil are also important, which allows influencing the balance of forces of intermolecular physical interactions in oil dispersed systems.

According to the International Energy Agency, global energy demand will increase by 30% by 2040 [1, 2], and therefore the problem of energy conservation is of particular importance. Many refineries aim to reduce the cost of the product by reducing energy costs. The main saving potential (90%) lies in the technological processes themselves, especially in the heat recovery scheme. In general, modernization aimed at improving energy efficiency and energy conservation should begin with the reactor system, separation system and heat exchange system. Proper design of the heat recovery system can significantly reduce the load on furnaces, steam heaters, as well as water and air refrigerators. Due to this, the reduction in energy consumption can be 10-20% (and in some cases up to 40-50%) of the initial energy consumption [3].
Along with energy saving, the correct design of heat exchangers (furnaces, condensers, refrigerators, reboilers, etc.), as well as reactors, scrubbers and other devices, modernization of technological installations in general, aimed at increasing production efficiency, can improve the environmental performance of refineries.
Energy savings on technological installations can be achieved, first of all, by such basic methods:
– optimization of the heat exchange system;
– involvement in the recovery of the maximum number of main technological and auxiliary flows;
– using highly efficient heat exchange devices.
Various measures are being taken in this direction at all major refineries. In relation to the heating furnace, which is the “heart” of almost any technological installation, to the associated equipment, to heat exchangers and other devices and units, it is necessary to reduce heat losses.

Table 1. Values of losses from various types of equipment at an oil refinery

Equipment	Heat loss capacity, t.t./year
Exposed pipe sections	1.3
Gate valve	3.0
Flange and pipe	1.2
Heat exchanger cover	2.9
Open parts of the heat exchanger	8.0
Pump	3.0
Bake	994.0

The values of losses from various types of equipment at an oil refinery are given in Table 1 [4].
As can be seen from the above data, the tubular furnace is characterized by the greatest losses (first of all, these are losses from the walls – 49% of the total factory heat loss).
The combination of technological installations allows to reduce the total energy losses. It should be noted here that domestic developments in the field of creating basic projects of new generation combined units for oil refining. In addition, it is extremely necessary to search for design solutions to increase the efficiency and energy saving of already operating installations, as well as to take measures to reduce costs both during oil production and transportation. All this taken together is designed to significantly increase the energy efficiency of the modern oil industry.

Production and delivery of oil to refineries

Oil production in the world in 2019 amounted to 89.9 million barrels per day. At the same time, as on a global scale, there is a tendency to weigh down oils, increase the content of resinous-

asphaltene substances (SAV), sulfur, nitrogen, metals. In any case, high-molecular hydrocarbons and non-hydrocarbon compounds contained in oil make it difficult, complicate and increase the cost of oil production, transportation and refining. Asphalt-resinous-paraffin deposits (ASPs) cause special difficulties at the first stage of oil production, namely during extraction, as well as transportation, storage [5, 6]. The formation of asphaltene deposits can occur both in the reservoir and in pumping and compressor pipes, pipelines and reservoirs. Precipitation of asphaltenes is very undesirable from the technological and economic side, because there is a need to perform work on the prevention and removal of deposits, which causes an increase in the costs of the process of extraction, transportation, storage of oil.

Asphaltene supramolecular structures significantly affect the paraffinization of wells, because, on the one hand, they do not allow paraffin-naphthenes to crystallize and fall out of the stream, and on the other hand, they themselves are initiators of paraffinization, forming large associates, which then coagulate and fall out on the surface of pipes [7-10].

The accumulation of ASF in the flow part of oilfield equipment and on the inner surface of pipes leads to a decrease in system performance, a decrease in the inter-repair period of wells and the efficiency of pumping units. From a chemical point of view, ASPs are a complex mixture consisting of paraffins (20-70 wt. %), resinous-asphaltene substances, or SAV (20-40 wt. %), silica gel resins, oils, water and mechanical impurities [11].

There are also oil dispersed systems belonging to the class of colloids in which the surfactants are dispersed in a maltene medium.

It is obvious that the physicochemical and technological properties of oils are largely due to the physical intermolecular interactions in the “asphaltenes-resins” and “maltenes–resins–asphaltenes" systems. The structure of resins and asphaltenes is usually considered as structures that are parallel naphthenic-aromatic layers connected to each other due to the formation of complexes with charge transfer. At the same time, there is some overestimation of the degree of ordering of asphaltenes, since they are considered as ideal crystals, although the quasi-crystalline part is a small fraction of the asphaltene substance (does not exceed 3-4 wt. %) [12].

Within one oil-producing region and even a separate field, the component composition of the ASF varies widely. Knowledge of the composition of ASPs is of practical importance for determining the optimal methods of combating them, in particular, for the selection of chemical reagents. This choice is often made based on the type of ASF. Extraction, chromatographic, thermal, spectral, electrochemical, etc. are used to study the composition and structure of deposits, as well as the composition of oils. methods of analysis [13-18].

The methods of preventing deposits of asphalt-resinous substances and solid paraffins are as follows: inhibition with the help of chemical reagents, improvement of compounding technology, wave and electromagnetic effects, use of heating cable lines, creation of anti–adhesive coatings on the inner surface of technological equipment, etc. [19-26].

A number of methods have been developed for cleaning deposits, namely, starting scrapers, washing with hot heat carriers, washing with hydrocarbon solvents, microwave and ultrasonic treatment, spot heating. It is clear that all this requires energy expenditure. Therefore, it is necessary to predict deposits during the extraction, transportation and processing of oil, examining the physico-chemical properties, the content of paraffins and surfactants, the dissolving ability of the dispersion medium, etc.

The content and structure of resinous-asphaltene substances has a significant impact on subsequent methods of oil preparation, primary and secondary processing, as well as on the quality of petroleum products. Some ways to increase efficiency and energy saving at oil refining plants at fuel profile refineries are discussed below. Therefore, the technologies of purification and production of oils are not considered in this review.

Oil refining technologies at modern refineries

In 2018, the global refining capacity reached 100 million barrels per day (5 billion tons per year). Two-thirds of the increase in oil refining volumes was provided by the Asia-Pacific region (China, India, Vietnam). The volume of annual oil refining in Russia in the last few years has been at the level of 280-290 million tons [27, 28].

In terms of oil refining, Russia ranks third in the world (after the USA and China). However, in terms of complexity (Nelson factor index), Russian refineries are inferior to developed countries [28].

The efficiency of the refinery depends on many factors. Its decrease may be caused by the instability of the operation of individual units of installations, malfunctions in the operation of separation devices, level fluctuations, foaming in apparatuses and foam transfer, hydraulic losses, incorrect readings of instruments, problems with the quality of steam and other reagents, damage to furnace pipes and heat exchangers, leaks, cavitation and damage to seals in pumps, etc. [29-31]. The most energy-intensive refinery facilities are technological installations.

The ways of increasing efficiency and energy saving at the main technological installations of modern fuel profile refineries are discussed below. The reforming process and HFCs are not included in this list, because the following review is planned for them.

Dehydration and desalination of oil

In the economy of oil transportation, dehydration and desalination of oil plays a huge role, as well as its stabilization already in the field. However, the refinery has to remove the remaining water and chlorides dissolved in it to reduce the cost of water evaporation and vapor condensation during the operation of direct oil distillation units. In addition, with insufficient desalination of oil, corrosion of the equipment is possible due to the hydrolysis of salts with the formation of acid. It should be emphasized that the ingress of metals into the raw materials of catalytic processes can cause poisoning of catalysts. In addition, the remaining salts, falling into heavy residues, increase the ash content of such petroleum products as boiler and ship fuel and petroleum coke [32].

Oil with a water content of approximately 1 wt is delivered to the refinery. %, salts 50-100 mg / l, which is achieved even in the field. The depth of desalination of oil at the factory electric desalting plant (FEDP) affects the residual salt content not only in oil, but also in fractions and, especially, in distillation residues.

For effective demulsification, the supply of a demulsifier to the oil is important. The consumption of the demulsifier depends on the resistance to delamination of the resulting water–oil emulsion and ranges from 2 to 15 g/t of oil. The stability of the emulsion is determined by the presence of natural stabilizers (emulsifiers) in oil – resinous asphaltene substances, refractory paraffins, as well as solid particles of sand, clay. These emulsifiers form a reinforcing layer around the water globule. Other things being equal, not only the consumption of the demulsifier depends on the degree of removal of solid particles during field oil treatment, but also the parameters of the oil

demulsification regime are improved [33]. Thus, the processing of water-oil emulsion in the field increases the efficiency of dewatering at the FEDP, where a combination of several factors affecting the system is used, which ensures effective separation of water and salts from oil. Complete separation of water has a positive effect on energy saving already during the subsequent direct distillation of oil, reducing the cost of evaporation of water and subsequent condensation of vapors [34].

Distillation and rectification

The primary oil distillation unit must ensure the specified selections and the quality of the target fractions. The preparation of raw materials by various influences, the improvement of heat exchange schemes, the use of modern contact devices reduces (and sometimes eliminates) the overlap of fractions, allows you to more fully and clearly select the appropriate shoulder straps for subsequent processes.

An analysis of the operation of vacuum columns both at domestic refineries and in foreign practice shows that deepening the vacuum to a residual pressure of 5-25 mm Hg is possible only with dry distillation (dry tower operate). At the same time, the flow rate of the circulating liquid to reduce the temperature of the top of the column is reduced by 2.5 times [35, 36].

The technological design of the oil fractionation process without the use of water vapor in the distillation sections of atmospheric and vacuum columns, in steam columns and ejectors provides the following main advantages:

− the water content of petroleum products is sharply reduced;

− reduces the load on the vacuum-creating equipment, which allows you to maintain a deep vacuum;

− reduces corrosion of equipment;

− reduces the consumption of recycled water and electricity, as well as the required surface of the capacitors.

In addition, it becomes possible to increase the performance of the installation.

As a rule, the FEDP is part of an installation combined with an atmospheric vacuum tube (AVT). The products obtained during distillation are mainly raw materials for subsequent refining processes of light fractions, as well as deep processing of heavy vacuum fractions and the residue of distillation. Often, column apparatuses of AVT installations do not work with full load, and the selections of light and vacuum fractions are carried out with a fuzzy selection of adjacent fractions during distillation, i.e. with a large overlap of fractions [37, 38].

For a more complete extraction of each narrow shoulder strap, it is necessary to correctly select the technological parameters of the rectification process mode. At the same time, sometimes some reconstruction of existing equipment is also required.

An important condition for increasing the selection of distillate fractions during distillation is the optimal mixing of oils to ensure their compatibility. Such compatibility (kinetic stability, stability of the mixture) is also important for reducing energy costs already at the stage of oil pumping [19, 22]. During distillation, the factor of optimal mixing of oils also plays a very significant role [39-45].

The influence of external fields and the use of various additives can also increase the efficiency of distillate selection during oil distillation due to the redistribution of hydrocarbons between coexisting phases [50].

It is possible to compare energy efficiency estimates based on the principles of pinch analysis. Pinch analysis is a methodology for minimizing the energy consumption of processes by calculating the required minimum energy consumption and achieving it through optimizing the heat recovery of the system, energy supply methods [51].
With the help of pinch analysis, the energy efficiency potential at one of the AVT installations was determined, a project of optimal energy-resource-efficient reconstruction of the installation with subsequent engineering modeling was developed [52, 53].

Catalytic cracking fluid (CCF)

Catalytic processes are the basis of today's oil refining technologies that ensure the production of modern fuels and raw materials for petrochemicals. The tasks of optimizing the operation of existing installations are very relevant, their successful solution is possible only on the basis of the use of modern tools and methods of mathematical modeling [54-56].
An important place in the schemes of a modern refinery is occupied by catalytic cracking in the fluidized bed of an aluminosilicate catalyst – catalytic cracking fluid (CCF, or FCC) - one of the main processes aimed at deepening oil refining. Among destructive processes, catalytic cracking occupies a leading place in the world in terms of capacity. Its specific weight is about 20% of the world's primary oil refining capacity [57]. Due to its adaptability to changes in the composition of raw materials and product nomenclature, as well as high profitability due to the difference in the cost of raw materials and the price of the products obtained, CCF is often the central process of the refinery.
The main market levers contributing to the development of a new generation of catalytic cracking technology [57, p. 267]:
− oil weighting (more than 50% of new installations in the world are designed for processing heavy types of raw materials;
− increase in demand for diesel fuel and decrease in gasoline;
– growing demand for petrochemical raw materials;
− reduction of emissions of oxides of SO_x, NO_x and dust.
The main directions of development of catalytic cracking:
− preparation of raw materials (hydrotreating, adsorption-contact cleaning, de−asphalting, etc.), which is especially important in connection with the weighting of raw materials; - improvement of catalytic systems;
− improving the designs of the reactor-regenerator unit (raw material input unit, the use of double risers taking into account the processing of heavy raw materials, the use of end equipment – riser, known as a vortex separation system, optimization of the geometric dimensions of cyclone separators, etc.) [58, 59].
KBR is currently developing the technology of catalytic cracking of residual raw materials (RFCC) [50, 58-60]. In the case of the use of heavy raw materials (atmospheric distillation residues or a mixture of vacuum residues and gas oils), its pre-purification is of particular importance. KBR company offers the use of a double diameter regenerator. The presence of an expanded part reduces the loss of the catalyst, minimizing its entrainment into cyclones. In addition, it is proposed to regenerate the catalyst with a lack of oxygen with equipping the installation with a CO afterburning boiler, which is done, firstly, to reduce harmful emissions, and secondly, in this case it becomes possible to use the thermal energy of flue gases. In order to

stabilize the operation of all equipment, the amount of raw materials supplied to the installation and the temperature at the outlet of the raw materials from the furnace are kept constant, regulating the fuel consumption in the furnace, and also improving the design of the nozzle for spraying raw materials and steam [61].

As a result of hydrotreating of raw materials by catalytic cracking and other methods of preparation, improvement of raw material injectors dispersing raw materials in the input unit, the use of new catalysts and various additives to them, modification of the reactor-regenerator unit, cyclone separators, optimization of the parameters of the technological regime, it is possible to increase the efficiency of the process. In addition to hydrotreating, other methods of activating raw materials are recommended to increase the efficiency of the process – the introduction of activating additives, wave action, etc. [62-66].

In recent years, CCF has increasingly become a dual–use process: the first is the production of a high–octane component of gasoline, the second is the production of propylene and butylenes – raw materials for petrochemicals. In the second case, cracking is carried out in a more rigid mode (the temperature in the reactor is increased to 550-570 ° C, structural changes are made to the equipment). All this increases the yield of propylene from 5-6 wt. % under normal cracking mode up to 20-21 wt. % – on propylene mode. This process is referred to as DCC (Deep catalytic cracking).

While pyrolysis is mainly aimed at producing ethylene, DC is suitable for the production of propylene and butylenes as the most popular on the market [67].

The production of light olefins, as well as the alkylation of isobutane with olefins in a block with the production of MTBE (methyl tert-butyl ether) and catalytic cracking is becoming increasingly important as a technological complex of a modern refinery.

At the same time, the petrochemical variant of catalytic cracking (DCC) is not the main variant of CCF today, both in the processing of vacuum gas oil and in the processing of residues, because the quality and quantity of gasoline of catalytic cracking is reduced. Therefore, its distribution in factories around the world is limited, and not a single installation has been built in Russia.

Alkylation

It is known that the most important component of commercial gasoline is alkylate, which surpasses most high-octane components in its properties. Debutanized alkylate has an octane number according to the research method 92-96, according to the motor method – 90-94.

The need to include the process of alkylation of isobutane with olefins in the scheme of a modern oil refinery is dictated by stricter requirements for the operational and environmental properties of commercial gasoline, namely, the content of olefins, aromatic hydrocarbons, as well as saturated vapor pressure [68-70].

The choice of alkylation technology is important for refineries. At the same time, many factors are taken into account, including capital and total operating costs, alkylate quality, production flexibility, reagent availability, product yield, maintenance issues, safety, etc. [71].

In recent years, solid acid alkylation technology has been actively developed abroad, which is safer than liquid acid technology (especially on hydrofluoric acid). This promising direction of using solid acid catalysts, due to its specific properties (compliance with environmental requirements and lack of corrosion activity), is an alternative to traditional industrial liquid acid catalysts [72-74].

Solid acid alkylation technology provides low capital and operating costs, high isobutane: olefins ratio, lower temperature, short contact time, flexibility in raw materials, ease of operation. According to the Program of Innovative Development of PJSC Gazpromneft until 2025, Gazprom Neft specialists together with scientists of the A.V. Topchiev Institute of Petrochemical Synthesis (INHS RAS) are developing a unique technology of solid acid alkylation using a safe zeolite-based catalyst at the company's Moscow plant. Within the framework of the project, a catalyst has already been created with an active working time of about a day sufficient for the organization of the production process. Now the new catalysts are undergoing pilot tests at a facility with a capacity of 300 tons of alkylate per year.

In addition, a new ISOALKY technology (Honeywell-UOP) is being developed – ion-liquid alkylation using a patented ion-liquid catalyst [75]. The developed catalyst has an acidity an order of magnitude higher than HF or H_2SO_4, and is also safer.

Visbreaking

Despite the fact that the production of heating oil is constantly decreasing (including in our country), visbreaking retains its importance as a relatively inexpensive thermal process taking place in fairly mild conditions, aimed at reducing the viscosity and pour point of vacuum residues and reducing the consumption of distillate diluents (primarily diesel fraction) to ensure the desired viscosity residual fuel.

Using visbreaking, it is possible to reduce the production of heavy petroleum fuels (heating oil) by 20-35%, and the need for distillate diluents by 20-30% [71, p. 135]. In addition, the process allows the residues to be processed into distillates, in particular into vacuum gas oil – the raw material of cracking. A specific task must be solved before the visbreaking installation is included in the refinery scheme, so that the economic benefit from the implementation of this inclusion is maximized.

At the same time, the visbreaking process has a limited future, since if there are coking and hydrocracking residues at refineries, it is more economically feasible to process vacuum residues on them.

There are two varieties of the process: 1) furnace, conducted in the coil of the furnace, which is both a heater and a reactor; 2) with a remote reaction chamber (cooking section). In both technologies, the products (after rapid cooling-quenching to stop the reaction) are sent to the separation column.

The second type of visbreaking has advantages over the furnace, because cracking proceeds at a lower temperature at the outlet of the furnace, then goes and ends in an unheated chamber (soking section) due to the heat accumulated in the furnace. This ensures lower fuel and electricity consumption, higher controllability of the process, due to the possibility of regulating two variables – the pressure in the cooking chamber and the temperature in the furnace [71, 76].

The visbreaking process with small investments allows, albeit slightly, but to increase the depth of oil refining, although its main goal is to obtain furnace fuel of a given viscosity.

The most well-known technologies are Shell, Lummus, UOP, Foster Wheeler. The Russian refineries also use the technology of the State Unitary Enterprise "Neftekhimpererabotka", which is distinguished by the use of a special device inside the reaction chamber that provides an ideal displacement mode [77].

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Delayed coking

The main contribution to the increase in oil conversion is made by the processes of processing heavy residual raw materials, the main of which is coking. This process is currently being given great importance all over the world, both because of the need to dispose of heavy residues to obtain the maximum amount of distillates and subsequent production of motor fuels, and in order to obtain coke of a predetermined quality for use in various industries. To this day, coking remains an economically successful technology for processing oil residues. The process is flexible enough to be integrated into a variety of technological schemes.

In recent years, the global capacity of coking plants has grown to 600 million tons/year [76]. China ranks first in terms of sales of petroleum coke. Other major producers of petroleum coke are the USA, Venezuela, India, Brazil and Canada. Sales of petroleum coke in the world amount to 180 million tons per year [78]. In countries with advanced oil refining, coking capacities are balanced with catalytic cracking and hydrocracking capacities, which ensures almost self-sufficient oil refining and allows significant savings in crude oil.

In Russia, for many years, the total volume of raw materials of coke plants was kept at the level of 6-6.5 million tons per year, in 2018 this figure increased to 13 million tons [78]. However, the needs of domestic metallurgy (in particular, the aluminum industry) and other industries in coke are constantly growing. For this reason, it is planned to increase the production of coke (especially anode and electrode).

Low-grade petroleum cokes are widely used as fuel in the world. Powdered petroleum coke is used as a fuel, in particular, in the cement industry. In recent years, coke has been burned more and more actively abroad in boilers with a circulating fluidized bed for the production of thermal energy, however, fuel coke is not used in Russia, which slows down the development of the coking process in the country.

It is known that those refineries that have coking plants in their composition are characterized by oil refining depth values of more than 90%, which exceeds the national average of 82-83% [79].

In the process of coking, heavy raw materials with a high content of sulfur and metals can be processed, for which the technology of continuous coking is suitable, especially the option with gasification of low-quality pulverized coke [80]. To obtain lump coke as a target product with predetermined properties, raw materials must be selected or specially prepared and processed using delayed coking technology [50, 80, 81].

The most important devices of any technological installation are tubular furnaces and heat exchangers. At the same time, the coking of heating equipment pipes is a big problem, especially when processing heavy raw materials. It is known that the basis of coking raw materials is tar, to which residues or heavy fractions of destructive origin available at this particular refinery can be added. By such dilution of raw materials, it is possible to ensure its uniformity and stability of the furnace by reducing coking, as well as to reduce the content of sulfur and metals in coke and improve its structure. Thus, along with the task of suppressing coke deposits, there is also the task of controlling the processes of coke formation of a certain structure and quality [81].

The colloidal state of the raw material plays an important role in the smooth operation of the furnace. In order to give it uniformity and resistance to the deposition of asphaltenes in the stationary phase, followed by their transformation into coke and, accordingly, coking of the furnace pipes, it is necessary to regulate the kinetic stability of the raw materials in advance, which allows prolonging the operation of the furnace, avoiding an emergency stop. Thus, the time

of continuous operation of the furnace and, accordingly, the installation as a whole increases. In addition, to reduce coke deposits in the furnace pipes, it is necessary to increase the speed of passage of secondary raw materials through the coil, thereby reducing the thickness of the coke layer in the pipes. According to the MagiCrot company from the CTC-EURO group of companies, increasing the thickness of the coke layer from 1/16 to 1/2 inch increases additional energy consumption by 50-60%. The method of cleaning pipes from deposits is important. The most perfect is the hydro-mechanical cleaning (de-coxification) practiced by MAGICROT. This method allows the flows in the furnace to return the design throughput, prolongs the service life of the pipes, reduces the cost of steam and water, reduces the downtime of the furnace, which gives significant cost savings [82].

Gasification of solid oil residues

The problem of processing heavy oil raw materials is becoming more and more urgent due to the weighting of the extracted oils and the increase in the production of various oil residues at refineries. At the same time, the need for residual fuels is reduced. All this requires efficient processing of heavy residual raw materials, which makes it possible to increase the depth of oil conversion into more valuable products [83, 84].

Gasification of solid oil residues can completely eliminate or significantly reduce their production. The gasification technology makes it possible to process refinery residues of any type, including petroleum coke (flexi-cooking process is known) [50, 80]. At the same time, it becomes possible to obtain valuable products, electricity, steam, hydrogen and various chemical raw materials at a low level of environmental harmful emissions.

Methanol and hydrogen can be produced from the synthesis gas obtained by gasification, or it can be processed into synthetic fuel through the Fischer-Tropsch process [58].

It is known that in economically developed countries, hydrocracking processes, characterized by high flexibility in obtaining a wide range of high-quality products, play a leading role in solving the problem of processing residual petroleum raw materials into commercial petroleum products. However, this process is expensive, requiring the use of a catalyst, preparation of raw materials, and high hydrogen consumption. Only hydrocracking in the suspended phase (old technology) has no restrictions on such indicators as the content of metals and SAV, and the depth of transformation of raw materials reaches 90-95% [85, 86]. Of all the old technologies developed abroad, the ENI process has been implemented in industry (the installation was put into operation in 2012). In Russia, a similar process developed by the INHS RAS allows processing atmospheric and vacuum residues of heavy high-viscosity oils and natural bitumen with a nanoscale catalyst to obtain refined light oil. The process was tested on a large pilot plant built in Iran [87, 88].

Currently, in the world (USA, Western Europe, Japan), several dozen installations for the steam-oxygen gasification of solid oil residues are operated, the purpose of which is the production of hydrogen for hydrogenation processes or process gas ($CO + H_2$) to produce cheap methanol – raw materials for the synthesis of the high-octane component of gasoline. The only waste of the process is granular slag with a high content of vanadium and nickel.

The largest suppliers of gasification technologies in the modern market are: Chevron Texaco (USA), Global Energy E-Gas (USA), Shell (USA, Netherlands), Lurgi (Germany), British Gas/Lurgi (Germany), Prenflo/Uhde (Germany), Noell/GSP (Germany), HT Winkler (HTW) RWE, Rheinbraun/Uhde (Germany), KRW (USA) [89]. In Russia, original work is also being

carried out in the field of gasification of residual raw materials, but no installations have been built at the refinery and there are no plans in the future [90].

In conclusion, it can be stated that the processes of oil extraction, transportation, preparation and refining are constantly being improved. This concerns the preparation of oil both in the field and at refineries, as well as the transportation of oil, the preparation of raw materials and the improvement of the technology of various processes – direct distillation, secondary processing of oil fractions and residues, gasification of heavy raw materials and petroleum coke. In addition, the design of the main components and devices of factory installations is constantly being improved and the heat recovery scheme of technological flows is being optimized. All this makes it possible to increase the efficiency of oil preparation and refining processes.

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NEFTİN HAZIRLANMASI VƏ EMALI PROSESLƏRİNİN SƏMƏRƏLİLİYİNİN ARTIRILMASI

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XÜLASƏ

Müxtəlif neft xammalının hazırlanması, daşınması və emalının əsas texnologiyaları onların təkmilləşdirilməsi yolları, enerjiyə qənaət, xammalın hazırlanması ilə səmərəliliyin artırılması, axın istiliyinin bərpası sxemlərinin optimallaşdırılması, avadanlıqların dizaynının təkmilləşdirilməsi və s. baxımından nəzərdən keçirilir.
Bu gün neft-kimya sənayesində ekoloji və iqtisadi komponentlərin yaxşılaşdırılması məsələsi kəskindir. Neft yataqlarında neftin təmizlənməsinin səmərəliliyinin artırılmasına xüsusi diqqət yetirilməlidir.
Mövcud ehtiyatlardan maksimum istifadə etmək, neft hasilatı, emalı və daşınması zamanı yarana biləcək neft məhsullarının itkisini azaltmaq lazımdır.
Statistika göstərir ki, istehlakçıya çatdırılma, maddənin vurulması və xam neftin emalı zamanı ildə ümumi neft məhsullarının kütləsinin 9% - ə qədəri itirilir.
Maddə buxarlanma nəticəsində bərpa olunur, yalnız kütlə itirilmir, həm də neft-kimya sənayesi üçün xammal olan maddənin vacib komponentləri.
Yanacaq emalı zamanı yüngül karbohidrogenlərin itkisi müşahidə olunur, müxtəlif növ drenaj əməliyyatları zamanı, həmçinin neftin bir vəziyyətdə daimi saxlanması zamanı baş verir. Neft emalı sənayesi proseslərini optimallaşdırmaq üçün əməliyyat zamanı daha az maddə itkisi təmin etmək lazımdır.
Yağın emal prosesində istifadəsinin səmərəliliyinin artırılması zəruridir, çünki bu, ən yaxşı neft məhsullarının seçilməsinə imkan verəcəkdir.
Səmərəlilik köhnə avadanlıqların yenisi ilə əvəz edilməsi və ya köhnə qurğuların əsaslı təmiri ilə artırıla bilər. Ancaq hazırda bütün müəssisələrdə avadanlıqların dəyişdirilməsi dövriyyə kapitalının olmaması səbəbindən sadəcə mümkün deyil.
Açar sözlər: müasirləşmə, enerji daşıyıcıları, istilik mübadiləsi, rekuperasiya, enerji səmərəliliyi, texnologiyalar, reaktorlar, sobalar, istilik mübadiləsi aparatları.

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ПОВЫШЕНИЕ ЭФФЕКТИВНОСТИ ПРОЦЕССОВ ПОДГОТОВКИ И ПЕРЕРАБОТКИ НЕФТИ

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РЕЗЮМЕ

Рассмотрены основные технологии подготовки, транспортировки нефти и переработки различного нефтяного сырья с точки зрения путей их совершенствования, энергосбережения, повышения эффективности за счет подготовки сырья, оптимизации схем рекуперации тепла потока, совершенствования конструкции оборудования и т.д.
Сегодня остро стоит вопрос улучшения экологической и экономической составляющих в нефтехимической промышленности. На нефтяных месторождениях особое внимание следует уделять повышению эффективности очистки нефти.
Необходимо максимально использовать имеющиеся запасы, снизить потери нефтепродуктов, которые могут возникнуть при добыче, переработке и транспортировке нефти.
Статистика показывает, что до 9% от общей массы нефтепродуктов теряется в год при доставке потребителю, перекачке вещества и переработке сырой нефти.
Вещество восстанавливается в результате испарения, при этом теряется не только масса, но и важные компоненты вещества, которые являются сырьем для нефтехимической промышленности.
При переработке топлива наблюдаются потери легких углеводородов, они происходят при различного рода операциях слива, а также при постоянном хранении нефти в одном положении. Чтобы оптимизировать процессы нефтеперерабатывающей промышленности, необходимо обеспечить меньшие потери вещества в процессе эксплуатации.
Повышение эффективности использования масла в процессе его переработки необходимо, так как это позволит отбирать лучшие нефтепродукты.
Эффективность может быть повышена путем замены старого оборудования на новое или путем капитального ремонта старых установок. Однако на данный момент замена оборудования на всех предприятиях просто невозможна из-за нехватки оборотных средств.
Ключевые слова: модернизация, энергоносители, теплообмен, рекуперация, энергоэффективность, технологии, реакторы, печи, теплообменные аппараты.

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STATISTICAL NATURE OF STRENGTH AND SCALE EFFECT IN MOUNTAIN ROCKS

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ABSTRACT

The theories and concepts of strength considered above are based on the model of a body either as a homogeneous structureless medium, or as a material having a structure, but uniform throughout its volume. Rocks are obviously not such bodies. They are composed of mineral grains of different properties, contain macrodefects in the form of pores and various inclusions, as well as objects of various aggregate states (gases, liquids). Under these conditions, deterministic theories of strength turn out to be clearly untenable.
In particular, the use of the classical theory of Griffith cracks is complicated by the following circumstance. Since the rock is an aggregate of mineral grains, a microcrack developing inside the grain inevitably reaches its boundary and, consequently, the radius *r* of the crack mouth increases abruptly. Therefore, for the transition of a crack to another grain and its further development, a stress greater than that follows from Griffith's theory is required. Thus, there is some "barrier" stress, at which only the development of a crack in a real rock is possible. In addition, the development of cracks in the rock occurs mainly along the contact of mineral grains, i.e., along the cementing material, often of a clay composition. For such a material, the theory of brittle fracture is applicable.
The destruction of the rock (from the standpoint of any theory of strength) is determined by the stresses acting in it. But due to the heterogeneous structure of the rocks, the local stress concentration centers are randomly distributed in its volume. Therefore, the strength and destruction of rocks must be considered from a statistical standpoint. This approach is justified for most other materials used by humans. The idea of the statistical nature of strength was first put forward in scientific terms by A.P. Aleksandrov and N.S. Zhurkov in 1933.
Keywords: rock strength, constant material, scale effect, rocks, destruction probability, fractured, robustness theory, microcrack, mineral, experience constant, density of defects, displacement, compression.

Introduction

The reviewed article is devoted to the analysis of theories of strength and criteria for the destruction of solids in relation to the specifics of rocks as inhomogeneous heterogeneous formations with a crystalline structure. The destruction of solids is such a complex and ambiguous process that to date there is no unified and workable theory of strength. However, this problem is so relevant for various fields of human activity that a purposeful scientific search has been conducted in this direction for hundreds of years. There are thousands of publications on this subject.

Formulation of the Problem. From the standpoint of the statistical concept, strength is not a material constant. Therefore, it is proposed to evaluate not the threshold value of stress, but the probability of body failure at a given load value. Thus, W. Weibull [14] proposed to estimate the probability of fracture of a body under uniaxial tension by the following expression:

$$P(\sigma) = 1 - exp[-V(\sigma - \sigma_\pi)^m \sigma_0^m], \quad (1)$$

where σ_π is a dimensionless quantity depending on the volume of the body being destroyed; σ_π is an experimental constant having the dimension of stress; σ_0^m is the threshold stress level, below which the failure probability is zero; m is a constant characterizing the density of cracks.
Numerous studies carried out in this direction have made it possible to obtain equations for the probability of failure for other types of stress and in a complex stress state. Common to all the proposed equations is the consideration of the degree of rock fracturing using the probabilistic laws of crack distribution.
With regard to rocks, V.N. Mosinets [10] proposed to evaluate the destructive stresses as follows:

$$[\sigma] = \sigma_p \text{- } C\sqrt{kA} \quad (2)$$

where σ_p is the strength of a homogeneous defect-free rock; C empirical coefficient (material constant); k is the coefficient of heterogeneity proportional to the concentration of microcracks in the rock; A is the specific work of deformation per unit volume of the rock.
The coefficient k is proposed to be estimated by the ratio of the energy of deformation of the fractured rock A_1 to the energy of deformation of an ideally homogeneous rock A_0 in the form:

$$k = \frac{1}{3}\left[\frac{A_1}{A_0} - 1\right] \quad (3)$$

In the simplest case, we can take $A = s_p^2/2E$, $A = \sigma_p^2/2E$ then equation (3) is transformed to the form:

$$[\sigma] = \sigma_p\left[1 - C\sqrt{\frac{k}{2E}}\right] \quad (4)$$

The Griffith failure criterion can be written as:

$$\sigma_p \cdot \sqrt{l} = K, \quad (5)$$

$$K = \sqrt{\frac{2E \cdot e_s}{\pi}}, \quad (6)$$

where l is the crack half-length; e_s is the specific surface energy of the body.
Provided that the number of cracks in the rock is large and they are distributed independently and randomly, the crack size distribution density can be described by the Cauchy equation [5]:

$$F(l) = exp\left\{-\left(\frac{l}{U}\right)^{-\alpha}\right\}, \tag{7}$$

where U and a are distribution parameters.
Then the probability of destruction of the rock can be determined by the equation:

$$P(\sigma) = 1 - exp\left\{-\left(\frac{K^2}{\sigma U}\right)^{-\alpha}\right\}, \tag{8}$$

Thus, having established the law of distribution of cracks in the rock, it is possible to predict the probability of its destruction at a given stress σ.

The most important advantage of the statistical approach is the ability to describe and quantify the influence of the scale factor on the strength of rocks. A large number of studies have been devoted to this issue [2, 1, 5, 3]. The main conclusions from these studies are as follows. The average (modal) strength value depends on the volume of the body being destroyed. This dependence is clearly non-linear, since the scale effect manifests itself to the greatest extent in small-sized samples. The effect is universal.

According to Griffith's theory, the strength of a body is inversely proportional to the square root of the size of a critical crack $\sigma \sim (1/l_{kr})^{\frac{1}{2}}$, i.e., the longer the crack length, the lower the strength of the body. In accordance with equation (1.43), the larger the crack, the less likely it is to appear in the rock. If we denote the relative crack length $l_{kr}/V = C$, then the probability function will be written as $P(l) = f(C, V)$. This means that the larger the body volume V, the higher the probability of a critical crack appearing there.

Thus, the most fruitful is the assessment of the scale effect from a statistical point of view, which in this aspect is reduced to the statistics of extreme values. Its main provisions can be summarized as follows.

1. For any material in a given stress state, there is a certain function of the probability of its destruction.
2. Any material by volume consists of m primary elements, the law of strength distribution of which is known.
3. The material is considered destroyed when at least one primary element from the whole set is destroyed.

Then, in order to assess the scale effect, it is necessary to establish the law of strength distribution (probability density) for a specific rock lithotype and evaluate the statistics of its extreme (minimum) values.

Probability theory [4] proves that if a measured quantity is influenced by many independent random factors, then such a quantity has a Gaussian distribution (normal distribution):

$$f(x) = \frac{1}{S\sqrt{2\pi}} exp\left[-\left(\frac{x-\bar{x}}{S\sqrt{2\pi}}\right)^2\right], \tag{9}$$

where $\bar{x}$ is the arithmetic mean (as an estimate of the true value of the measured quantity a); S is the standard deviation.

Indeed, experimental studies [7] and literature data [12] indicate a normal distribution of rock strength values. In this case, the integral function of the probability of destruction of a given sample with volume V_0 at stresses σ no more than χ is determined by the equation:

$$F(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\frac{(x-\chi)}{S}} e^{-\frac{t^2}{2}} dt \tag{10}$$

Where $.t = (\chi - \alpha)/S$

The probability that a sample of a given size will not fail under stress σ will be $1 - F(\sigma)$; and for a sample with a volume that is m times larger, it is $[1 - F(\sigma)]m$. Then the probability of destruction of the sample with a volume m times greater than the initial V_0 will be:

$$\mathrm{P}(\sigma) = 1 - [1 - F(\sigma)]^m \tag{11}$$

According to the theory of statistics of extreme values, the function $\mathrm{P}(\sigma)$ as m→ ∞ will tend to the asymptotic Gumbel distribution:

$$G(\chi) = 1 - exp\left[\frac{\chi-\mu}{\sigma}\right], \tag{12}$$

where μ is the position parameter; σ is the scale parameter.

The parameters of the equation depending on the scale m are determined by the formulas:

$$\mu(m) = \bar{\chi} + v_1(m); \tag{13}$$

$$\sigma(m) = Sd(m) \tag{14}$$

For sufficiently large m $(m > 50\text{-}\ 100)$, the coefficients of these equations can be calculated using asymptotic formulas:

$$v_1(m) = -\sqrt{2lnm} + \frac{lnlnm + ln4\pi}{2\sqrt{2lnm}}, \tag{15}$$

$$d(m) = \frac{\pi}{\sqrt{2lnm}}. \tag{16}$$

For small m, i.e., when estimating the scale effect for small volumes of rocks, the asymptotic approximation can give a significant error. In this case, it is necessary to find the exact solution of the Gumbel equation (12) using the formulas:

$$v_1(m) = \int_{-\infty}^{+\infty} t\{1 - [1 - F_0(\chi)]^m\} dt, \tag{17}$$

$$v_2(m) = \int_{-\infty}^{+\infty} t^2\{[1 - F_0(\chi)]^m\} dt, \tag{18}$$

$$d(m) = \sqrt{v_2(m) - v_1^2(m)}\ . \qquad (19)$$

where $F_0(\chi)$ is the normalized Gaussian function (for $\alpha = 0$ an S=1).
The scale effect estimation procedure is as follows. According to the results of the laboratory determination of the strength of samples with small volume V_0, the statistical hypothesis is tested about the normal distribution of experimental data with the parameters: arithmetic mean χ_0 and standard deviation (standard) S_0. If the hypothesis is not refuted, according to formulas (17)-(19), depending on the required scale m, new values of strength $\chi_m = n_1(m)$ and standard deviation $S_m = s(m)$ are determined.
However, the disadvantage of such a model is that the normal distribution is not limited from below, i.e., with a large variation in single definitions, negative strength values may appear. In addition, for a number of rocks (for example, with a non-uniform distribution of defects in a sample), it is possible that the distribution of experimental strength data is different from normal. In these cases, the Weibull distribution seems to be the most acceptable, which is limited in the region of minimum values and, for certain values of its parameters, is also capable of describing the normal distribution of data.
Formula (10) can be reduced to a Weibull equation of the form [5]:

$$F(\sigma) = \begin{bmatrix} 1-exp\left[-\left(\frac{\sigma-\mu}{\beta}\right)^K\right] \\ 0, \end{bmatrix}, \qquad \begin{matrix} \sigma>\mu \\ \sigma<\mu, \end{matrix} \qquad (20)$$

where β is the scale factor parameter having the dimension of stress; μ is the minimum strength value; K is the coefficient of homogeneity of the rock.
This cumulative Weibull distribution function is defined by three parameters: β, μ, and K. From a formal mathematical standpoint, it is unsolvable. To find the parameters of a function, it is proposed in [5] to use a system of three equations expressing the equality of the distribution skewness, arithmetic mean, and standard deviation to their mathematical expectations. The solutions of these equations using the gamma function are tabulated and given in the form of tables. The selection of the parameters of the Weibull equation is also possible by the method of successive approximations using the required number of iterations.
However, it seems more preferable to estimate the parameters μ and K by analyzing the structural features of a real rock. Thus, the parameter μ represents the lower limit of strength, which (depending on the type of problem being solved) can be defined as an asymptote of the graph of strength reduction with an increase in the size of the rock or according to the characteristics of the block structure of the rock mass. The homogeneity coefficient K directly depends on the degree of rock fracturing, which can be measured in the experiment. So, according to [5], for homogeneous metals it changes from 10 to 25: for rocks $K = 1 - 4$.
In the same work, for a direct calculation of the rock strength of a given volume V, the following equation is proposed:

$$\sigma_V = \sigma_{min} + \frac{\beta}{V^{\frac{1}{K}}}, \qquad (21)$$

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where $\sigma_{min} = \mu + \beta(-lnP)^{\frac{1}{K}}$ is considered as the minimum statistically probable strength value at the accepted significance level P.
The considered methods for estimating the scale effect, based on the statistical concept of strength, are based on the difference in the structure of rocks of different volumes in their initial state (before the experiment). However, already during the loading of the rock, its structure changes; the fracture process may include ductile and brittle stages, and the characteristics of this process may also depend on the scale [11, 13]. Thus, it can be assumed that the scale effect has a dual nature.
Considering the scale effect mechanism from the standpoint of the kinetic concept of strength, B.N Tsai [13] points to the dependence of the parameter $\gamma = qV_f$ in the durability equation on the scale of destruction. The overstress coefficient of interatomic bonds q depends on the length l_i formed during the destruction of microcracks. It is assumed that cracks in large-volume samples can reach large sizes. The fluctuation volume V_f is related to the dimensions of the plastic zone at the crack tip, which change during the transition from the ductile to the brittle stage of fracture and the duration of the process, which, in turn, also depends on the volume of the body. Finally, in large volume samples, the probability of the appearance of large thermal energy fluctuations increases. Apparently, these effects take place, but their a priori quantitative assessment is practically impossible. Recognizing this, the author of [13] proposes an estimate of the scale effect in the form, $\psi = (D_1/D_2)^{1/4}$ where D are the linear dimensions of the sample. However, this estimate does not take into account the statistics of defects in the rock at all and can hardly be used for different rocks. Therefore, the factor of changes in rock fracturing during their loading requires additional studies that will allow us to quantify these effects.
Thus, in [11], when considering the scale effect from the point of view of thermal fluctuations, it is assumed that the structural coefficient γ depends on the total number of cracks N in the body being destroyed. With a normal distribution of defects

$$\gamma_{max} = \gamma + \beta\sqrt{2lnN} - \beta\frac{ln(4\pi lnN)}{2\sqrt{lnN}}, \quad (22)$$

where β is the standard deviation of the crack distribution.
Hence it follows that with an increase in the number of cracks N in the body, the value of γ_{max} increases and, consequently, the threshold of destructive stresses decreases. Therefore, the larger the destruction volume, the higher the value of N and the lower the strength of the body.
One of the promising directions for assessing the scale effect is the energy approach. Thus, in [6], based on the consideration of fracture as a two-stage process, the following equation is proposed:

$$\sigma^2 L = A\lambda E = const, \quad (23)$$

where L is the size of the body destroyed by the stress σ; λ is the specific work of crack growth. The latter indicator takes into account both the work of elastic and plastic deformations during crack growth.

Conclusion

The theories and concepts of strength considered above are based on the model of a body either as a homogeneous structureless medium, or as a material having a structure, but uniform throughout its volume. Rocks are obviously not such bodies. They are composed of mineral grains of different properties, contain macrodefects in the form of pores and various inclusions, as well as objects of various aggregate states (gases, liquids). Under these conditions, deterministic theories of strength turn out to be clearly untenable.

In particular, the use of the classical theory of Griffith cracks is complicated by the following circumstance. Since the rock is an aggregate of mineral grains, a microcrack developing inside the grain inevitably reaches its boundary and, consequently, the radius r of the crack mouth increases abruptly.

The destruction of the rock (from the standpoint of any theory of strength) is determined by the stresses acting in it. But due to the heterogeneous structure of the rocks, the local stress concentration centers are randomly distributed in its volume. Numerous studies carried out in this direction have made it possible to obtain equations for the probability of failure for other types of stress and in a complex stress state. Common to all the proposed equations is the consideration of the degree of rock fracturing using the probabilistic laws of crack distribution.

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СТАТИСТИЧЕСКАЯ ПРИРОДА ПРОЧНОСТИ И МАСШТАБНЫЙ ЭФФЕКТ В ГОРНЫХ ПОРОДАХ

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РЕЗЮМЕ

В основе рассмотренных выше теорий и представлений о прочности лежит модель тела либо как однородной бесструктурной среды, либо как материала, имеющего структуру, но однородную по всему объему. Камни, очевидно, не являются такими телами. Они сложены минеральными зернами разных свойств, содержат макродефекты в виде пор и различных включений, а также объекты различного агрегатного состояния (газы, жидкости). В этих условиях детерминистские теории прочности оказываются явно несостоятельными.
В частности, использование классической теории трещин Гриффита затруднено следующим обстоятельством. Поскольку порода представляет собой совокупность минеральных зерен, микротрещина, развивающаяся внутри зерна, неизбежно достигает его границы и, следовательно, радиус устья трещины r резко увеличивается. Поэтому для перехода трещины в другое зерно и дальнейшего ее развития требуется напряжение большее, чем это следует из теории Гриффита. Таким образом, возникает некоторое «барьерное» напряжение, при котором возможно только развитие трещины в реальной породе. Кроме того, развитие трещин в породе происходит в основном по контакту минеральных зерен, т. е. по вяжущему материалу, часто глинистого состава. Для такого материала применима теория хрупкого разрушения.
Разрушение горной породы (с точки зрения любой теории прочности) определяется действующими в ней напряжениями. Но из-за неоднородного строения горных пород локальные центры концентрации напряжений распределены в ее объеме хаотично. Поэтому прочность и разрушение горных пород необходимо рассматривать со статистической точки зрения. Такой подход оправдан для большинства других материалов, используемых человеком. Представление о статистической природе прочности впервые в научном плане было выдвинуто А.П. Александровым и Н.С. Журков в 1933 году.

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DAĞ SÜXURLARINDA MÖHKƏMLİYİN VƏ MİQYAS TƏSİRİNİN STATİSTİK XARAKTERİ

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XÜLASƏ

Nəzərdən keçirilən möhkəmlik nəzəriyyələri və konsepsiyaları cismin ya homojen struktursuz mühit kimi, ya da strukturu olan, lakin bütün həcmində bircins olan material kimi modelinə əsaslanır. Dağ suxurları açıq-aydın belə cisimlər deyil. Onlar müxtəlif xassələrə malik mineral dənələrdən ibarətdir, məsamələr və müxtəlif daxilolmalar şəklində makroqüsurları, həmçinin müxtəlif məcmu vəziyyətlərdə olan obyektləri (qazlar, mayelər) ehtiva edir. Bu şərtlər altında, deterministik möhkəmlik nəzəriyyələri açıq-aydın etibarsız olur.
Xüsusilə, Griffith çatlarının klassik nəzəriyyəsinin istifadəsi aşağıdakı vəziyyətlə çətinləşir. Süxur mineral dənələrin məcmusu olduğundan, dənənin daxilində əmələ gələn mikroçat qaçılmaz olaraq onun hüdudlarına çatır və nəticədə çat ağzının r radiusu kəskin şəkildə artır. Buna görə də, çatın başqa dənələrə keçməsi və onun sonrakı inkişafı üçün Qriffitin nəzəriyyəsindən irəli gələn daha böyük bir gərginlik tələb olunur. Beləliklə, bəzi "maneə" gərginliyi var ki, bu zaman yalnız həqiqi dağ suxurlarında çatın inkişafı mümkündür. Bundan əlavə, qayadakı çatların inkişafı əsasən mineral dənələrin təması boyunca, yəni sementləmə materialı boyunca, tez-tez gil tərkibli birləşmələr boyunca baş verir. Belə bir material üçün kövrək dağılma nəzəriyyəsi tətbiq olunur.
Süxurun dağılması (hər hansı bir möhkəmlik nəzəriyyəsi nöqteyi-nəzərindən) ona təsir edən gərginliklərlə müəyyən edilir. Lakin süxurların heterojen quruluşu ilə əlaqədar olaraq, yerli gərginlik konsentrasiyası mərkəzləri onun həcmində təsadüfi olaraq paylanır. Buna görə də, süxurların möhkəmliyi və dağılması statistik baxımdan nəzərə alınmalıdır. Bu yanaşma insanlar tərəfindən istifadə edilən əksər digər materiallar üçün əsaslandırılmışdır. Möhkəmliyin statistik mahiyyəti ideyası ilk dəfə elmi dildə A.P.Aleksandrov və N.S. Jurkov 1933-cü ildə istifadə edib.
Açar sözlər: dağ suxur möhkəmliyi, sabit material, miqyas effekti, süxurlar, dağılma ehtimalı, çat, möhkəmlik nəzəriyyəsi, mikroçat, mineral, təcrübə sabiti, qüsurların sıxlığı, yerdəyişmə, sıxılma.

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IRRADIATION OF CARBON DIOXIDE WITH A VACUUM UV SOURCE AND OBTAINING OF STRATOSPHERIC OZONE

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ABSTRACT

It has been known for more than 100 years that carbon dioxide absorbs photons in the ultraviolet and infrared ranges of radiation, creating a greenhouse effect. However, so far no one has answered the question: what is a photon?

It is known that a photon has corpuscular and wave properties, has a certain pressure. An interesting experiment was carried out when a photon was dissected using Wilson chamber and it left traces of the opposite sign. The correct conclusion was made that one trace in the Wilson chamber was left by an electron, and the other - by a positron.

There were other experiments, for example: birefringence of light in quartz crystals, Icelandic spar, etc., but there were no correct conclusions made about what a photon is.

A photon is an electric dipole, consisting of an electron and a positron charges, without a spin charge-conjugate formation, which has a dipole magnetic field.

Carbon dioxide, absorbing photons with a mass of $18.2 \cdot 10^{-31}$ kg, being structured in the core, turns into triatomic oxygen, that is, into stratospheric ozone.

A photon absorbs only a carbon atom that has an excess of spins. Photons absorbed by carbon dioxide (electric dipoles) having a magnetic field interact with the magnetic force lines of the dipole magnetic field of the Earth, and as a result of such interaction, triatomic oxygen-ozone moves into the stratosphere. Stratospheric ozone is not explosive in all aggregate states and at high pressures. In the atmosphere, it enters into a nuclear interaction with neutrons emanating from the sources of future earthquakes, forming water. So, naturally, the ozone layer of the Earth is depleted, replenishing the hydrosphere.

Irradiation of CO_2 and production of stratospheric ozone is a solution to the problem of climate warming. Stratospheric ozone can be widely used in the defense industry. An airship filled with stratospheric ozone will be much more efficient than airships filled with hydrogen or helium.

The production of stratospheric ozone from carbon dioxide is a fundamental discovery in the field of photonuclear physics.

Key words: electric dipole, photon, carbon dioxide, stratospheric ozone, photonuclear reaction.

Introduction

It is known that carbon dioxide absorbs photons and creates a greenhouse effect, which has a destructive effect on climate change processes. It is known about photons that in the phenomena

of interference, diffraction, and polarization they exhibit wave properties, and, for example, in the photoelectric effect, black body radiation, spectra of atoms and molecules, etc., they exhibit corpuscular properties.

According to classical concepts, a wave and a particle are mutually exclusive physical models and cannot represent the same object. An electric dipole, consisting of an electron charge and a positron charge and having a mass of $18.2 \cdot 10^{-31}$ kg is such a physical model with wave and corpuscular properties [1].

Task setting. Utilization of carbon dioxide and obtaining stratospheric ozone.

Task solving method. We obtain stratospheric ozone by exposing carbon dioxide to ultraviolet radiation in the vacuum range.

Task solution. Carbon dioxide, absorbing photons of a certain range, that is, electric dipoles with a mass of $18.2 \cdot 10^{-31}$ kg, gradually turns into ozone. Absorption takes place in the carbon nucleus.

The photonuclear reaction of converting carbon dioxide into stratospheric ozone looks like this:

$$CO_2 \xrightarrow{h\nu} O_3 + p$$

From the foregoing, it can be seen that the absorption of photons leads to the reaction of displacement of a proton from the carbon nucleus, and instead of the displacement of a proton, the nucleus will continue to absorb photons.

Thus, the carbon nucleus absorbs electric dipoles with a mass equal to 5 (five) protons. It is known that the proton is 1836 times larger than the mass of the electron, which means that it is 1836:2 = 918 times larger than the electric dipole. Taking into account the displaced proton we find that carbon absorbs, $5 \times 918 = 4590$ electric dipoles (photons), no more and no less.

We have not found an explanation for the stratospheric ozone mass defect in any scientific publication. If stratospheric ozone was formed from an oxygen molecule as a result of a photochemical reaction, then why is the diatomic oxygen that we breathe located in the surface layer, and the triatomic oxygen - in the stratosphere?

This phenomenon is explained as follows: a large number of photons absorbed by carbon dioxide - electric dipoles - leads to their interaction with the magnetic force lines of the Earth's dipole, magnetic field and it moves the formed ozone into the stratosphere. What happens to the absorbed photons in the nucleus requires a special study. It can be only assumed that they turn into mesons.

Thus, from carbon dioxide, as a result of a photonuclear reaction, stratospheric ozone is formed.

Ozone, obtained by known technologies from oxygen, as a result of a photochemical reaction, a barrier discharge, electrolysis or exposure to a high-frequency electric field, decomposes again into oxygen. In addition, it is explosive at concentrations above 15%.

However, ozone, obtained from carbon dioxide, as a result of a photonuclear reaction, is extremely stable and explosion-proof in any state of aggregation. Therefore, stratospheric ozone can be widely used in industry. But if it is simply released into the atmosphere, then to a certain extent it is possible to positively influence the ecology of the environment [2].

Currently, there is an intensive study of the planet Mars. But we propose to continue the study of the planet Venus. In the atmosphere of Venus, according to the data of flights of interplanetary space stations of the Venera (USSR) and Mariner (USA) series, carbon dioxide reaches 97 % at an atmospheric pressure of 100 atm. At present, as a result of the absorption of photons of the

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vacuum range coming from the Sun, the atmospheric pressure on the planet Venus is decreasing due to the formation of stratospheric ozone.
This research result will make it possible to predict the appearance of an atmosphere similar to the Earth's, in about 150 - 200 Earth years. And approximately in 2000 years a biosphere will appear on the planet Venus. By this time period, the biosphere on planet Earth will cease existence.
The proposed method can utilize almost all greenhouse gases included in the list of the Kyoto Protocol.
We carried out 8 experiments with a low-efficiency source of vacuum ultraviolet, with a mercury lamp PRK-4-1-0.2 brand. The analyzes were carried out on an LKhM-80 chromatograph [3].
Subsequently, it was decided to conduct an independent examination, under the supervision of a commission formed of prominent scientists and specialists. This was accomplished at the Research Institute "Geotechnological Problems of Oil, Gas and Chemistry" under the chairmanship of Professor A. L. Shabanov.

Results and suggestions

The results of the analysis before and after irradiation showed that the CO_2 content decreased from the initial 98.5 % to 1.5 - 2.5 %. Using a chromatograph with a plasma ionization detector, it was possible to show that the gas obtained as a result of a photonuclear reaction burns. The analysis on this chromatograph was carried out two months after irradiation, which made it possible to conclude that the resulting product is non-explosive and stable over time (Figure 1).

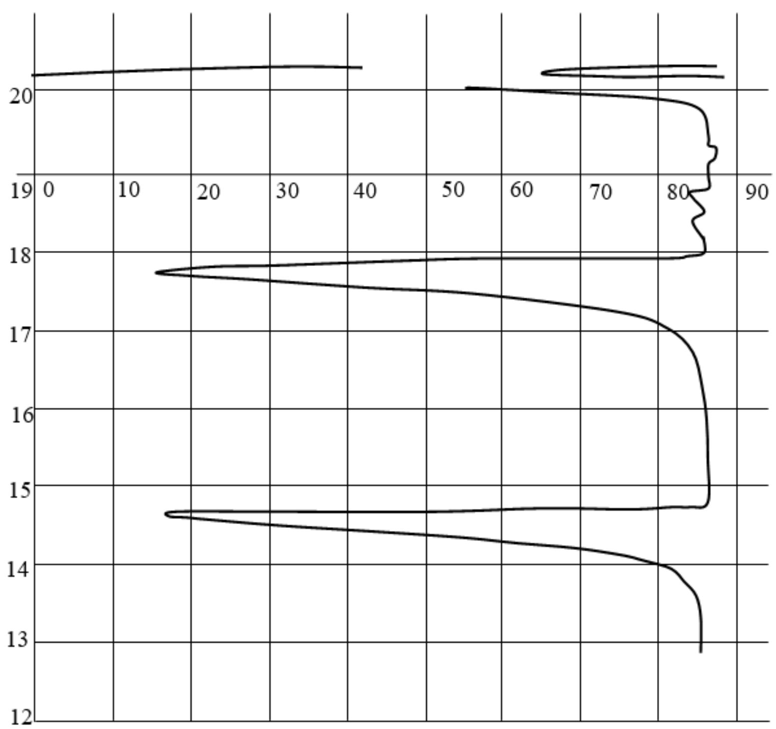


Figure 1: Results of the analysis of the ozone content by a chromatograph with a plasma ionization detector.

A modern source of vacuum ultraviolet, for example, made in Japan, will allow to get a result within a few hours.

Conclusions

The obtaining of stratospheric ozone from carbon dioxide is a fundamental discovery in the field of photonuclear physics, the application of which, to a certain extent, will make it possible to positively influence the processes of climate change on Earth.

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KARBON QAZININ VAKUUM ULTRABƏNÖVŞƏYI MƏNBƏ İLƏ ŞÜALANDIRILMASI VƏ STRATOSFER OZONUNUN ALINMASI

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XÜLASƏ

100 ildən atrıq məlumdur ki, karbon qazı ultrabənövşəyi və infraqırmızı diapazondakı fotonları udaraq, istixana effekti yaradır. Lakin indiyə qədər heç kim tərəfindən foton nədir sualına cavab verilməyib.

Məlumdur ki, foton korpuskulyar və dalğa xassələri ilə yanaşı müəyyən təzyiqə də malikdir. Belə bir maraqlı eksperiment aparılmışdır; Vilson kamerasının köməyi ilə fotonu parçalamışdılar və o əks işarəli iz buraxmışdır. Bu zaman Vilson kamerasında izin birinin elektron, digərinin isə pozitron olduğu kimi düzgün nəticə çıxarmışlar.

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Başqa eksperimentlər də aparılmışdır; məsələn, island şpatı və kvars kristallarda işıq şüasının ikiqat sınması və s., lakin fotonun nə olduğu haqqda düzgün nəticə çıxarmamışdılar.
Bizim fikirimizcə foton elektronun və pozitronun yükündən ibarət elektrik dipolu olub dipol maqnit sahəsinə malik, spinsiz yükqoşulu bir materiyadır.
Karbon qazı kütləsi $18{,}2 \cdot 10^{-31}$ kq olan fotonları udaraq və müvədə strukturlaşaraq üç atomlu oksigen, yəni stratosfer ozonuna çevirilir.
Fotonu yalnız spin artığı olan karbon atomu udur. Maqnit sahəsinə malik olan, karbon qazı tərəfindən udulan fotonlar (elektrik dipolları) Yerin maqnit sahəsi dipollarının maqnit güc xətləri ilə qarşılıqlı təsiri nəticəsində üçatomlu oksigen-ozon stratosferə yerini dəyişir. Bütün aqreqat hallarında stratosfer ozonunun partlamaq qorxusu, hətta yüksək təzyiqlərdə belə, yoxdur. O atmosferdə, gələcək zəlzələ ocaqlarından çıxan neytronlarla nüvə qarşılıqlı təsirə girərək, su əmələ gətirir. Beləliklə təbii ki, Yerin ozon təbəqəsi hidrosferanı dolduraraq zəifləyir.
CO_2-nın şüalandırılması və stratosfer ozonun alınması klimatın istilənməsi probleminin həlli olmaqla yanaşı o müdafiə sferasında geniş istifadə oluna bilər. Stratosfer ozonu ilə doldurulan drijabl hidrogen yaxud heliumla doldurulmuş drijabldan daha effektli olacaq.
Karbon qazından stratosfer ozonunun alınması fotonüvə fizikası sahəsində fundamental kəşfdir.
Acar sözlər: elektrik dipolu, foton, karbon qazı, stratosfer ozonu, fotonüvə reaksiyası.

ОБЛУЧЕНИЕ УГЛЕКИСЛОГО ГАЗА ИСТОЧНИКОМ ВАКУУМНОГО УЛЬРАФИОЛЕТА И ПОЛУЧЕНИЕ СТРАТОСФЕРНОГО ОЗОНА

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РЕЗЮМЕ

Более 100 лет известно, что углекислый газ поглощает фотоны в ультрафиолетовом и инфракрасном диапазонах излучения, создавая парниковый эффект. Однако, до сих пор никто не ответил на вопрос: что такое фотон?
Известно, что фотон обладает корпускулярными и волновыми свойствами, обладает определённым давлением. Был проведён интересный эксперимент, когда с помощью камеры Вильсона расчленили фотон и он оставил следы противоположного знака. Сделали правильный вывод, что один след в камере Вильсона оставил электрон, а другой- позитрон.
Были и другие эксперименты, например: двойное лучепреломление света в кристаллах кварца, исландского шпата и др., но правильных выводов о том, что такое фотон, никто не сделал.

Фотон, это электрический диполь, состоящий из заряда электрона и заряда позитрона, безспиновое, зарядовосопряжённое образование, имеющее дипольное магнитное поле.
Углекислый газ, поглощая фотоны, имеющие массу $18{,}2 \cdot 10^{-31}$ кг, структурируясь в ядре, превращается в трёхатомный кислород, то есть в стратосферный озон.
Фотон поглощает только атом углерода, имеющий избыток спинов. Поглощённые углекислым газом фотоны (электрические диполи) обладающие магнитным полем, взаимодействуют с магнитно-силовыми линиями дипольного магнитного поля Земли, и в результате такого взаимодействия трёхатомный кислород-озон перемещается в стратосферу. Стратосферный озон не взрывоопасен во всех агрегатных состояниях и при высоких давлениях. В атмосфере он вступает в ядерное взаимодействие с нейтронами, исходящими из очагов будущих землетрясений, образуя воду. Так, естественно, истощается озоновый слой Земли, пополняя гидросферу.
Облучение CO_2 и получение стратосферного озона является решением проблемы потепления климата стратосферный озон может быть широко применён в оборонной сфере.
Дирижабль, заполненный стратосферный озоном будет значительно эффективнее дирижаблей с водородом или гелием.
Получение стратосферного озона из углекислого газа является фундаментальным открытием в области фотоядерной физики.
Ключевые слова: электрический диполь, фотон, углекислый газ, стратосферный озон, фотоядерная реакция.

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$$f(x) = a_0 + \sum_{n=1}^{\infty} \left(a_n \cos \frac{n\pi x}{L} + b_n \sin \frac{n\pi x}{L} \right) \quad (1)$$

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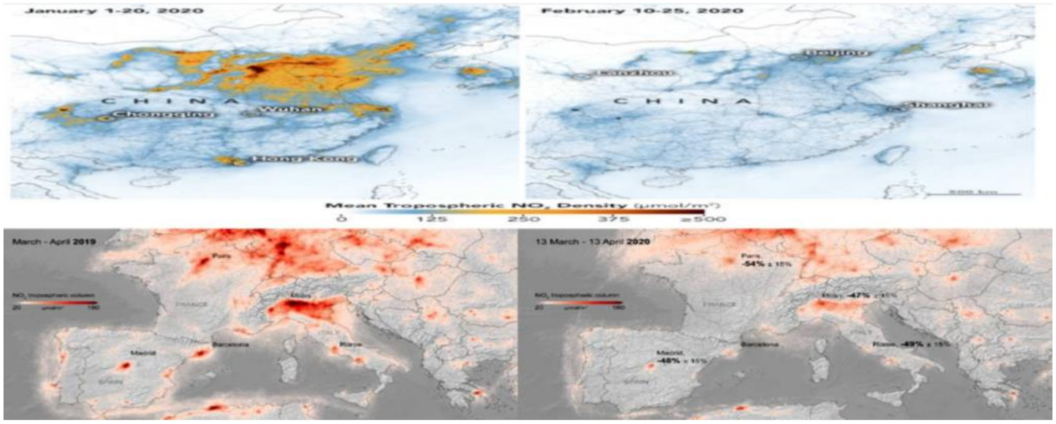


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1. W. S. Author, "Title of paper," Name of Journal in italic, vol. x, no. x, pp. xxx-xxx, Abbrev. Month, year. https://doi.org/10.21467/ajgr
2. Bahishti, "Peer Review; Critical Process of a Scholarly Publication", J. Mod. Mater., vol. 2, no. 1, pp. 1.1-1.2, Oct. 2016. https://doi.org/10.21467/jmm.2.1.1.1-1.2
3. Bahishti, "A New Multidisciplinary Journal; International Annals of Science", Int. Ann. Sci., vol. 1, no. 1, pp. 1.1-1.2, Feb. 2017. https://journals.aijr.in/index.php/ias/article/view/163
4. W. S. Author, "Title of paper," Name of Journal in italic, vol. x, no. x, pp. xxx-xxx, Abbrev. Month, year. Access online on 20 March 2018 at https://www.aijr.in/journal-list/advanced-journal-graduate-research/
5. W. S. Author, "Title of paper," Name of Journal in italic, vol. x, no. x, pp. xxx-xxx, Abbrev. Month, year. Access online on 5 March 2018 at https://www.aijr.in/about/publication-ethics/

6. M. Ahmad, “Importance of Modeling and Simulation of Materials in Research”, J. Mod. Sim. Mater., vol. 1, no. 1, pp. 1-2, Jan. 2018. DOI: https://doi.org/10.21467/jmsm.1.1.1-2

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